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VOL. XXIII. NEW YORK, APRIL 28, 1894. NO. 17.

CONTENTS.

Editorial 561
A Transmission Dynamometer, by Louis Duncan 563
Incandescent Lamp Litigation 563
American Institute of Electrical Engineers 563
Electric Traction in England 564
Electric Canal Towing 564
The Midwinter Fair—I 565
Destructive Effects of Electrical Currents on Subterranean Metal Pipes, by I. H. Farnham 567
Hamburg Electric Tramway 568
Magnetic Qualities of Iron, by J. A. Ewing and Helen G. Klaassen 569
Rope Driving—XI., by J. J. Flather 570
The Electrical World's Digest of Current Technical Electrical Literature, compiled by Carl Hering 573
Suggestions for Transit Systems, by S. D. Mott 576
Tests of Car Heaters 577
Calculation of Alternating Current Motors—VIII., by E. Arnold 577
Improved Tandem Compound Engine 579
Mechanical Stoker 580
Purity Oil Filter 580
A New Window Spring 581
New Three-Phased Apparatus 581
Telephone Outfit 582
New Incandescent Lamp 582
H gh-Speed Automatic Engine 583
An Indicating Push Button 583
Metallic Shade and Stand 583
Motor-Driven Engine Lathe 584
Incandescent Lamp Adjuster 584
New Books 585
DEPARTMENTS:
Financial 586
Special Correspondence 587
News of the Week 588
Trade and Industrial Notes 591
Business Notices 591
Illustrated Record of Patents 592

RATIOS.

Through a slip of the pen in our last issue the statement appeared that if π instead of 10 were the basis of our numerical system, the ratio of the circumference of a circle to the diameter would be unity. The error was so apparent, however, that doubtless all of our readers noticed it. A ratio, of course, is independent of the system of units employed, for if one thing is, for example, five times as great as another thing, no matter what the units employed may be, the ratio is five. The ancient mathematicians instead of dealing directly with magnitudes, employed ratios whenever possible, as the absence of any scientific or accepted systems of units would otherwise have rendered their work unintelligible in parts. While in modern calculations the idea of ratios is always present, the possession of accepted units does away with the necessity of formally expressing it in all operations.

THE BATE REFRIGERATOR CASE.

The United States Circuit Court of Appeals of New York has certified the Bate refrigerator case up to the United States Supreme Court for decision, the inference being that as the point of law at issue would finally have to be adjudicated by the highest court the judges considered that valuable time might be gained by sending it there at once. As before explained, the issue involved is whether the date of application for a United States patent or the date of issue shall prevail in applying the statute limiting the life of a domestic patent by that of a foreign one. At present the law is that a domestic patent expires with any foreign patent issued prior to the date of issue of the former. Should the Supreme Court reverse the law in its decision on the present case, the effect will be to prolong the life of the Edison incandescent lamp and microphone and other important electrical patents to the full term of seventeen years. All previous decisions have been against this construction of the statute, and the opinion of those most competent to judge is that the case is a "forlorn hope," with little chance of a favorable decision.

TRANSMISSION DYNAMOMETERS.

One of the most necessary pieces of apparatus in every laboratory and one of the most desirable for the commercial testing room is a transmission dynamometer, as the efficiency of an apparatus that has the greatest importance is, as a rule, the ratio between the power transmitted and that supplied. It was owing to the absence of transmission dynamometers in tests that the electrical efficiency of a dynamo was for a long time accepted as a criterion of the true efficiency, whereas in fact such a dynamometer might have shown that a machine with a high electrical efficiency had really a relatively low commercial efficiency. In another column Dr. Duncan describes a transmission dynamometer, which, as stated, forms an exceedingly convenient apparatus for some purposes, and has the advantage of not requiring any material connection to the apparatus to be tested. This adds another to the list of valuable testing apparatus and methods devised by Dr. Duncan, which comprises among others an absorption dynamometer on the principle of Joule's apparatus, thermal methods of testing transformers and other electrical apparatus and the well known method and apparatus for obtaining instantaneous values of alternating current curves, which have served as the model for so many others.

THE MIDWINTER FAIR.

In this number we give the first installment of an article describing the technical features of the Midwinter Fair at San Francisco. The details of the method of using petroleum for fuel will be found instructive. Although the amount of fuel burned is equivalent to more than 30 tons of coal per day, during the evenings, when the load is about 2,500 h. p., only two firemen are required to be on duty—only one being in attendance on the furnaces—and the duties of neither are laborious. As the amount of coal that would have to be fired during this time would probably approach four tons per hour, the great saving in men and of muscular energy is apparent, while the improvement in cleanliness, space and absence of smoke is correspondingly great and particularly desirable in the present instance. As will be seen, but little change need be made with some forms of boilers to admit of the use of petroleum for fuel, and it would seem that the advantages offered are sufficient to justify an investigation with a view to displacing of coal by central stations that can ill spare the space now occupied by the latter and the necessary firing space in the boiler room. The question of forced draught during the hours of heavy load would also thus be neatly solved, as the mere turn of a valve wheel would give the necessary increase, as compared with the increased force of men and the use of blowers, with the accompanying deterioration of boilers necessary, when coal is the fuel.

ELECTRIC TRUNK LINES.

The long talked of electric road from Philadelphia to Harrisburg will, it is said, soon be built. This is the project headed by ex-United States Senator Patterson, formerly of South Carolina, and it is understood that sufficient stock has been disposed of to build the entire line, which, the officials state, will be finished within eighteen months. The surveys have all been made, and it has been decided to use the two-phased alternating current system for transmission and the continuous current for operating the cars. There will be a large central station with step-up transformers and sub-stations with step-down transformers at distances of twelve to fifteen miles, where step-down and rotary transformers will convert the alternating currents into continuous currents of 500 volts. The road will have four tracks, with a private right of way, which has, it is said, been secured for the entire length of the line. The line will be fenced in and have no grade crossings. There will be numerous branches, and two of the four tracks will be reserved for local business. It is proposed to equip the high speed through cars, which will be 68 feet long, with four 40-h. p. motors, and it is intended to run them at a speed of 40 or 50 miles per hour. This scheme seems to be the best studied of any yet proposed, but it will be seen that the local traffic feature is the one most prominent. Running through a rich and thickly settled district, the road, with its feeders, should have a large local traffic that in itself would justify its construction. The generation of all the power from one central station is a promising feature, and the outcome will be looked forward to with much interest. If successful the result may lead to the establishment of large generating stations to supply extensive areas with current not only for the various street railway lines within its limits, but also current for lighting from sub-stations in the included towns. Of other long-distance electric railway projects, the Chicago-St. Louis and the Indiana-Chicago schemes seem to have gone to sleep, but instead we have offered an electric elevated line from Cleveland to New York, of which, however, not much has been heard lately. The network in northern New Jersey is being gradually extended, and the rumor is periodically revived that connection will soon be made with the Trenton and Camden systems, and thus complete a through electric line from New York to Philadelphia. In some cases it will perhaps be found that projects for electric trunk lines merely conceal schemes to secure rights for local traffic that could not otherwise be obtained.

NOMENCLATURE AND SYMBOLS.

Our English contemporary, the "Electrician," devotes one of its able, though "slashing," editorials to the subject of nomenclature and symbols, in which Hospitalier's system of symbols is criticised and the provisional names for the magnetic units adopted by the American Institute of Electrical Engineers referred to. While it is said in regard to the symbols proposed by Prof. Hospitalier that it is doubtful whether a thoroughly representative international congress could, by discussion or amendment, produce a much better set, yet for all that many writers will still decline to alter their custom and adopt the characters thus offered. While the refusal of such writers might be justified in regard to some of the symbols, such as *I* for current, it would not be justified in regard to the symbols for the magnetic quantities. The symbols proposed for these by Hospitalier are in accordance with the usage of the masters of electrical science, and the type, having faces similar to that of ordinary type, do not disfigure a page like the heavy gothic letters favored by English electricians. These symbols as proposed, it may be remarked, are not "ragged German capitals," but simply pen-text characters, and in manuscript or on the blackboard are written merely as script capitals. Owing to the time-honored use of *C* for current, it is now probably too late to have the symbol *I* adopted, but as the gothic letters have only had a limited employment and have little or no chance of universal adoption, it would be much to be deplored if English writers were to adhere to them instead of adopting the congress symbols, which, with their aid, would undoubtedly become universal. The principal objection of our contemporary to the provisional names of the magnetic units is aimed at the gilbert, which it pronounces useless, probably from erroneously considering that it is to displace the ampere turn. The product of the magnetic flux by the reluctance is the magneto-motive force; if names are given to the two former it would be absurd to leave the latter nameless, so that the three names will stand or fall together. Again, if the magnetic flux and reluctance are expressed in terms of the C. G. S. units, or in webers and oersteds, their product is magneto-motive force in C. G. S. units, or in gilberts, which can only be turned into ampere turns by multiplying by a factor; or, in other words, whenever we wish to determine magneto-motive force our result is first in terms of gilberts, and that it might be directly in terms of ampere turns we would instead have to apply a factor to the expression for flux or reluctance, which would be not only illogical but absurd. Our contemporary does not consider the strongest argument in favor of names for the magnetic units, which is that thereby a concrete idea is given to the different quantities. The mathematical physicist accustomed to deal with abstractions does not require to be thus assisted, but the ordinary electrician is accustomed to deal only with concrete ideas and names, and the idea of reluctance, for example, will not take the same hold on him as that of resistance until he can express it by a definite name divorced from abstract accompaniments, as he now expresses resistance in ohms.

Pumping by Electricity.

The Worcester (England) municipality will utilize its plant, put in for supplying electricity for lighting, to run electric motors for pumping purposes at its waterworks, instead of employing steam, as originally intended. There will be two 30-h. p. alternate current motors having a guaranteed efficiency of 90 per cent., working pumps capable of delivering 10,000 gallons of water per hour to an elevation of 300 feet through three miles of 10-inch pipe.

A Transmission Dynamometer.

BY DR. LOUIS DUNCAN.

The transmission dynamometer which I am going to describe has been found useful for some special experiments for a number of years. I have used an absorption dynamometer, consisting of a copper disc rotating in a magnetic field. The power was calculated from the pull on the magnet and the speed of the disc. The heat was absorbed by water running through the apparatus. This dynamometer is of a rather limited range, unless belting is resorted to. For the purpose of trying some experiments on the efficiency of air propellers, a transmission dynamometer was designed on somewhat the same principle. It consisted of a copper disc fastened to the propeller to be rotated and placed in the field of a rotating electromagnet. The apparatus was calibrated by turning the magnet at known speeds and measuring the pull of the disc, which was kept stationary. After this, to measure the power transmitted, it is simply necessary to know the speeds of the field magnets and the copper disc, and the pull is proportional to the difference of the speeds, and can be obtained from the calibration curve. The disc is so constructed that it can be cooled by allowing water to flow on it in such a manner as not to absorb power, and a temperature correction can be applied if necessary. The speed of the disc can be regulated by varying the speed of the magnets and the strength of the magnetic field. In this way power can be transmitted without the intervention of any belt or gearing, and it forms an exceedingly convenient apparatus for some purposes.

Johns Hopkins University, Baltimore, Md.

Incandescent Lamp Litigation.

Counsel for the General Electric Company appeared before Judge Colt, of the United States Circuit Court, held at Boston on April 14, in two incandescent lamp cases, one against the Davis Electrical Company, of Springfield, Mass., and the other against the Boston Incandescent Lamp Company. The General Electric Company was represented in both cases by Mr. Fish, and the Boston Incandescent Lamp Company by Judge Lowell and Son. The former case was an action for contempt, it being alleged that the Davis company, against which an injunction had been secured by the General Electric Company some time ago, was continuing to repair incandescent lamps by sealing into the top of the bulb a small piece of platinum and claiming thus to avoid infringement, on the ground that this made other than an "all-glass" chamber. The court failed to see the force of this claim, and issued an order in favor of the General Electric Company.

In the latter case an injunction was asked restraining the Boston Incandescent Lamp Company from manufacturing incandescent lamps. The lamps as manufactured by the Boston Incandescent Lamp Company do away with the use of leading-in wires, using as conductors two strips of a finely divided film of silver; these are made to adhere to the sides of a glass tube by means of printers' ink, which, when the tube is melted and pinched together, oxidizes and disappears. Iron wires are inserted in either end of the tube before it is pinched together, to which the carbon filament is attached.

Mr. Fish contended that the lamp infringes by having an all-glass chamber, a vacuum maintained inside, and a carbon filament, thus infringing the second claim of the Edison patent. Judge Lowell claimed that it did not infringe the patent, owing to the absence of leading-in wires sealed in the glass. Mr. Fish, in his reply, stated that the only difference between a wire and the finely divided film was in the distance between the molecules. It was also claimed by the plaintiff that according to Prof. Cross there was nothing new or novel in using a finely divided film to transmit a current of electricity, it having been known as early as 1861, as well as the knowledge of the proper amount necessary to replace a wire of a given size. According to the affidavit of Prof. Walsh for the defense, it was claimed that the process of commercially leading the current into the lamp by means of a strip of finely divided metal was new and ingenious from a scientific point of view. The defense gave figures showing the great saving in expense in using the finely divided silver over the use of platinum, to meet the affidavits of the plaintiffs, which claimed the divided silver to be more costly.

The court took the case under advisement, saying it involved important points of law, and that it would try and reach a decision as soon as possible.

American Institute of Electrical Engineers.

The 86th meeting of the Institute was held at 12 West 31st street, New York City, April 18, President Houston in the chair. The secretary announced the death of Dr. Franz Schulze-Berge at Brooklyn on March 21, and stated that an appropriate obituary notice would be printed in the "Transactions."

Upon recommendation of the Committee on Units and Standards, an informal vote was taken expressing the sense of the meeting as favorable to the passage of a bill by the United States Congress legalizing the electrical units adopted by the Electrical Congress of 1893 at Chicago.

The paper of the evening was read by Mr. I. H. Farnham, of Boston, on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," and was profusely illustrated with lantern slides. The final views, showing the electrolytic action of the current, were watched with great interest by an audience of over one hundred. The discussion was opened by Prof. Plympton, of Brooklyn, and participated in by Messrs. Kennelly, Emery, Waldo, Houston and others, the remarks of Mr. Kennelly on the bearing and weight of the various factors entering into the question being particularly well received. A communication upon the subject was also read from Mr. Lockwood. Other communications from Prof. Thomson and Mr. Lemp were received too late to be read at the meeting. The slides used have been sent to Mr. A. V. Abbott, at Chicago, who will represent the author at a meeting of the Western members, to be held at the Armour Institute, April 25.

At the meeting of council in the afternoon, the following associate members were elected:

A. T. Best, Florida; Charles A. Carus-Wilson, Montreal, P. Q.; Frank R. Colvin, New York; John C. George, Baltimore, Md.; James H. Gerry, 163 Grand avenue; James Wm. Gladstone, West Orange, N. J.; Henry M. Hobart, Schenectady, N. Y.; Ralph O. Hood, Boston, Mass.; William C. Hubbard, New York; Eugene Ingold, Pittsburgh, Pa.; Edwin S. Keefer, New York; Charles H. Macloskie, Chicago, Ill.; Samuel G. Neiler, Chicago, Ill.; Thomas L. Proctor, Newtown, L. I., N. Y.; A. L. Searles, New York; C. J. Toerring, Jr., New York, and Walter S. Wiley, South Omaha, Neb.

The following associate members were transferred to full membership upon the recommendation of the board of examiners:

S. Dana Greene, Schenectady, N. Y.; Rudolf Eickemeyer, Yonkers, N. Y.; John Thomas Morrow, Great Falls, Mont.; A. Langstaff Johnston, Philadelphia, Pa.; Joseph Edwin Crandall, Washington, D. C.

Mr. Elmer G. Willyoung, chairman of the local committee at Philadelphia, who was present, informed the secretary that active preparations were being made in that city for the coming annual and general meeting of the Institute, May 15, 16 and 17. The Engineers' Club has offered to throw open its house for the use of the Institute, and it is proposed to make the Bingham House the headquarters. Messrs. Houston and Kennelly offer the use to visiting members of their offices in the Betz Building, near the Pennsyl-

vania Railroad station, to which they may have their mail addressed. The first meeting of the Institute after its organization was held in Philadelphia in 1884, and its return to the Quaker City seems an appropriate celebration of its tenth anniversary, marking, as it does, the close of the year showing the largest growth in membership since its foundation.

The annual meeting will be held in the afternoon of May 15. At this session the results of the election of officers will be announced and the reports of the council and treasurer read. Other matters to be brought up will probably be the revision of the election rules and recommendations of the Committee on Units and Standards. The annual dinner of the Institute will occur in the evening. Wednesday and Thursday will be devoted to the reading and discussion of papers, the list reported by the committee being as follows:

Discriminating Lightning Arresters and Recent Progress in Means for Protection Against Lightning, Alexander Jay Wurts.

The Law of Hysteresis (Part III.) and the Calculation of Ferric Inductances, Charles P. Steinmetz.

Alternating Currents and Fuse Wires, Dugald C. Jackson and R. J. Ochsner.

The Waste of Zinc in Open Circuit Batteries When Standing Idle, Henry A. Lardner.

Some Storage Battery Phenomena, W. E. Griscom.

Central Station Economy, C. Reginald Van Trump.

A Review of the Progress of the American Institute of Electrical Engineers, Edwin J. Houston.

Standardizing Electrical Measuring Instruments: (a) By the Potentiometer Method, (b) An Improved Direct Reading Potentiometer, Elmer G. Willyoung.

Experiments with Two-Phase Motors, Louis Duncan.

Test for Closed Coil Arc Dynamo, R. B. Owens.

Relative Advantages of Toothed and Smooth-Core Armatures, Alton D. Adams.

Resonance Analysis of Alternating and Polyphase Currents, M. I. Pupin.

Unipolar Dynamos for Electric Light and Power, F. B. Crocker.

In the April number of the Institute "Transactions," Figs. 6 and 13 were transposed, and on page 204, third line from bottom, the word "positive" should be "negative."

Electric Traction in England.

(From Our Own Correspondent.)

With the revival in commercial enterprise generally, we are witnessing a similar revival in connection with electric railway enterprise in the metropolis. There are now some half a dozen schemes with parliamentary powers waiting to come before the public for the necessary money; one concern, the Central London Railway, has been in possession of parliamentary powers for over two years, and so far has done absolutely nothing towards carrying out the scheme, although they have indeed attempted to secure an extension into the next century of the term within which they must commence work. The week before last the public were asked to subscribe to the electric railway which is to run from Waterloo Railway station into the City, and has the financial and technical support of the London and South Western Railway Company. This week one and one-half million sterling is asked for the Charing Cross, Euston and Hampstead Railway, which is to be an electrical tubular railway about five miles in length, running from the Charing Cross terminus of the South Eastern Railway, due north across London, almost on the top of Hampstead Heath. As this line starts in the West End and terminates in a very favored residential district, crossing en route some very densely populated quarters, it seems to possess several of the most important requisites of a financial success.

It is interesting to note in this connection the immense gain obtained by the employment of motor cars in preference to electric locomotives. The weight of a two-motor car "train" on the Liverpool Overhead Railway is thirty-eight and one-fourth tons when full, and seating 114 passengers, the corresponding figures for the City and South London Railway Company being thirty-seven and one-third tons, and 96 passengers. These figures work out that at Liverpool the weight of a full train per passenger is 752 pounds, whilst on the City and South London line the figure is 871 pounds. The gain is shown in another way by the fact that at Liverpool the maximum tractive force per ton of motive apparatus is 730, whilst on the City and South London line the figure is 367 pounds.

The "Times" has recently devoted a considerable portion of its space to a well-considered resume of the subject of light railways, giving a very complete analysis of what has been done on the continent of Europe, where it would appear that although the indirect gains due to the construction of such lines are thought to be considerable, there is no doubt about the fact that the direct losses in most cases are also considerable, especially where the state has had a very big finger in the pie. In Holland, where these light railways, which usually take the form of steam tramways, are, for the most part, carried out by private enterprise, and the tracks laid along the highways, a fair measure of pecuniary success has attended the undertakings. The "Times" advocates the construction of similar lines in English agricultural districts, with a view of affording some assistance to our farmers in bringing their produce cheaply to market, and I regret to say our leading journal displays a decided tendency towards the advocacy of state or municipally aided lines. If Parliament will permit powers to be obtained for the construction of light railways in a sensible and inexpensive fashion, if the Board of Trade will permit a suitable departure from its normal standard of railway construction, if the local authorities concerned will grant free use of the highways, and if the people concerned have a little capital and enterprise left in them, it is possible we might before long witness the construction of what, I think, you would call agricultural "freight lines." There are, however, too many "ifs" in the matter for one to anticipate anything in the shape of a "boom." Whenever these light railways come along, however, electrical engineers should certainly have the monopoly of the making of them.

Electric Canal Towing.

To the Editor of The Electrical World:

In your current issue of April 17, 1894, Volume XXIII., No. 14, page 471, is illustrated the "Electric Canal Towing System" of Mr. T. D. Davis, of Syracuse, N. Y.

Apparently the only claim that Mr. Davis makes for his system is that more boats can be moved through the locks.

While it may be questioned whether this claim can be upheld, it would be interesting to see how he figures out the gain to be equal to the cost of installing a single-track railway on each side of the canal, even though it be narrow gauge.

The system for the electric canal propulsion will probably be the two-wire trolley system, with a return to some form of "baby carriage trolley," such as was used in 1884 and 1885, with a flexible connection between the over-running trolley and the boats. The question of the number of boats to be taken in tow is evidently similar to the number of trail cars on an ordinary trolley road, and is simply provided for in the increased size of the motor on the "motor boat."

J. S. B.

Effect of Heat on Lead Pipes.

The London "Elec. Review," March 30, calls attention to the fact that heat, such as from exhaust steam, causes lead pipes to expand, after which they do not contract, thus causing bad warping. Perhaps a similar effect will take place with lead covered cables.

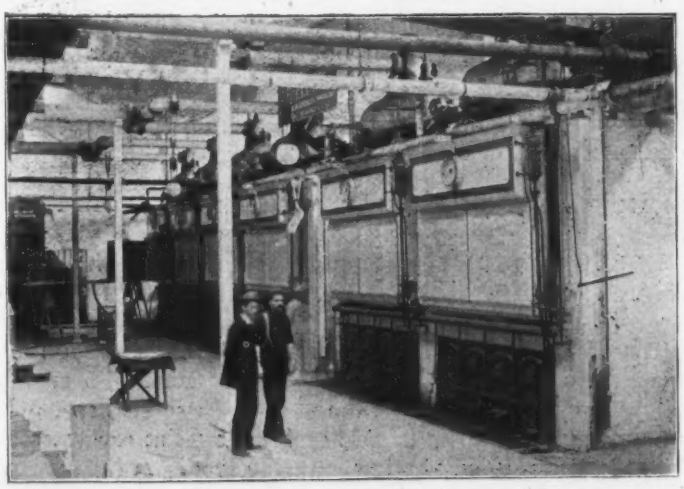
The Mid-Winter Fair.—I.

THE California Midwinter International Exposition has proved in many respects even a greater success than had been anticipated; and while it does not lay claim to the magnitude and magnificence of its greater rival, the World's Columbian Exposition, it possesses a peculiar interest of its own. The electrical features are well worthy of attention, and perhaps the most fitting introduction to a consideration of them is a description of the heart and soul of the installation—the steam plant.

The steam plant at the Midwinter Fair consists of eight Heine sectional boilers of 375 h. p. each, or a total of 3,000 h. p. They are arranged along one side of the boiler room, which is an annex to the Machinery Hall, in two groups of four boilers each, with a space of several feet between the two groups.

Each boiler has one large furnace 9 feet 1 inch wide, 16 feet deep and about 5 feet high, with four doors and draught openings to each. Crude petroleum is used as a fuel, and to adapt the boilers to this the bridge walls and grate bars have been removed and the entire bottoms of the furnaces covered with fire bricks. Pieces of broken fire bricks are also thrown in to make a mass that will retain heat for a considerable period. The bottom of a furnace is much lower than would be the case with coal as a fuel, it being but little above what is the bottom of the combustion chamber and ashpan when these boilers are arranged for coal burning. The very large furnace formed is necessary with oil fuel, because the combustion is entirely in the form of flame, there being no incandescent mass to radiate heat, as with coal.

The door openings are closed with a screen of loosely laid red bricks, except a peephole about 3 inches square through which the furnace can be examined; and this screen is so effective in preventing radiation into the fireroom that even when one is looking through the peephole but little heat



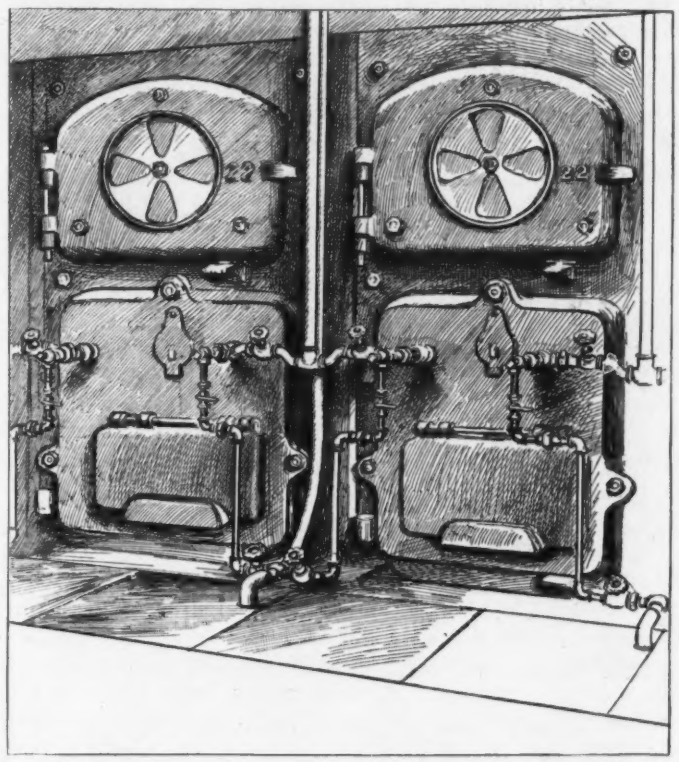
GENERAL VIEW OF BOILER ROOM.

can be felt, though the temperature of the furnace is very high.

Each boiler is fitted with eight Graves burners for crude petroleum. These burners are very simple, and the results obtained with them seem to show that little room is left for improvement. They were tried by the Heine company at Chicago, but the results obtained are said to be far less satisfactory than in this plant.

This burner was patented in 1890, the moving cause for the invention being that the inventor, Mr. Graves, had a brickyard, and thought he could turn out a better product by using a fuel that burned with the largest possible amount of flame. Gas would give this, but was expensive, so he turned to the use of oil. He failed to find a burner that suited him, and devised the one which now bears his name. The accompanying sketch will make the construction and operation plain.

The burner consists of a cast iron body, *A*, which is threaded on an enlargement, *B*, and screwed into the furnace front so that the nozzle extends a short distance into the fur-

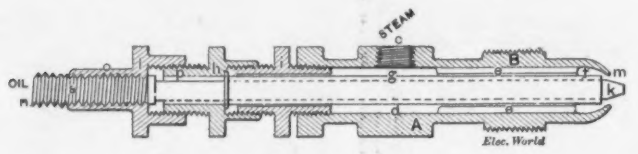


VIEW OF BOILER FRONTS SHOWING OIL TUBES.

nace. Live steam is admitted through *c* into a chamber, *d*, at the after end of the body, and is conveyed by a half-dozen whirling motion, which causes a thorough mixture with the rifle grooves of great pitch, *e e*, to the annular space *f* at the nozzle, from whence it enters the furnace with a rapid, oil. A piece, *i*, screws into the base of the body casting and acts as a guide for a thin brass tube, *g*, which is brazed to a piece, *h*, which screws on *i*, as shown, and has an extension, *p*, threaded with a right-hand thread. The length of the tube *g* is such that by screwing *h* back a free passage is made for the steam to escape through the nozzle, and by screwing *h* forward the end of the tube closes the nozzle and entirely shuts off the steam. Between these two extremes the flow of steam can be regulated to any extent. A piece, *l*, screws on *p*, as shown, and has an extension, *o*, which is tapped with a left-hand thread having the same pitch as the right-hand thread on *p*. It is made of considerable length, as shown. A pipe, *s*, screws into *o*, and is brazed to a brass tube, *k*, which passes through the tube *g* and extends a short distance beyond the nozzle, *m*. The end of tube *k* is contracted to 1-8-inch diameter, as shown. By turning *l*, the tube *k* is fed forward by the motion of *l*, and also in virtue of its left-handed thread, as it is prevented from turning by being screwed to the pipe line. In order to allow for the

forward motion of *s*, it is secured to the pipe line by a double elbow connection, thus forming a swinging joint. The primary object in threading *s* was to produce a steam-tight joint in *o*, but in addition it feeds *s* forward twice as fast as the nut *l* travels. The steam-tight joint is more efficient and more easily made than would be a shoulder on a ground joint in *l*.

The oil enters tube *k* through a 1-4-inch pipe under a pressure of 12 pounds per square inch, and discharges through the 1-8-inch nozzle with force sufficient to throw a stream about four or five feet when no steam is turned on. Steam enters at *c* through a 3-8-inch pipe, the full boiler pressure being used. The high temperature in the body and about the tube raises the oil to nearly the temperature of the steam before it escapes into the furnace. The steam having a high rotary motion, the oil is completely vaporized



SECTIONAL VIEW OF OIL BURNER.

and the combustion is perfect, no combustible residue whatever being left in the furnace or on the tubes. The flame fills the entire furnace, showing the necessity of ample room.

When the boiler is set up and the desired oil pressure is attained in the pressure tank the positions of tubes *g* and *k* are adjusted with reference to each other and to the nozzle of the burner, and no further change is necessary, so long as the pressures of oil and steam are not altered.

In starting up, steam is admitted to the chamber and the tubes heated; then oil is turned on, and the hot spray formed is ignited by means of a piece of burning waste. The oil and steam supply are regulated by means of cocks in their respective pipes, and in a few seconds the combustion can be changed from the condition of banked fires to the full power of the furnace. When starting up a boiler a slow fire can be started, and will maintain itself for hours without any attention whatever.

In case of accident to a tube or failure of the water supply, so that the tubes are in danger of burning, the fire can be instantly extinguished, as there is no heavy body of incandescent fuel to be handled, as with coal. These excellent qualities are, of course, inherent in the use of oil as a fuel and have nothing to do with the type of boiler used.

In this plant the eight burners to each furnace, each supplied with oil at 12 pounds pressure through a 1-4-inch pipe and steam at boiler pressure through a 3-8-inch pipe, are sufficient to maintain 400 h. p.

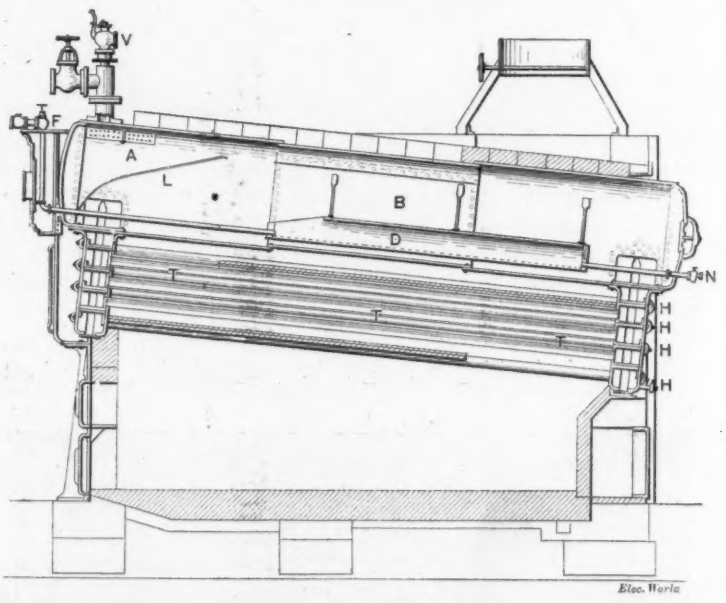
The method adopted in the Heine boiler for carrying the hot gases over the tubes would seem to be advantageous when oil is used as a fuel, because by removing grate bars and bridge wall the large furnace needed is formed. As is well known, in the Heine boiler the forward portion of the tubes over the grate bars and bridge is shielded from the direct action of the flame, and the products of combustion pass to the back of the combustion chamber, then up into the tube space, where they are again forced forward by means of a second deflecting plate over the top of the tubes. At the forward end of the tubes they escape to the space beneath the drum, then aft again to the stack. This construction allows the forming of one large combustion chamber of the entire space beneath the tubes without interfering in any manner with the remainder of the setting, and complete combustion can take place before any portion of the vaporized oil can be chilled by contact with the tubes.

Other forms of sectional boilers can no doubt be arranged for equally efficient use of oil fuel, but some change in the setting would seem to be necessary in order to produce a combustion chamber of requisite size.

The Southern Pacific Railroad Company has built a branch line to the Fair grounds, the track ending in the rear of Machinery Hall. Just outside the boiler room a large pit was dug and lined with wood, and in this are two iron tanks, each holding 7,500 gallons, or a total of 15,000 gallons. Tank cars are run to the pit and the oil piped into the receiving tanks. Each tank is fitted with a float, the stem of which extends above ground and indicates the quantity of oil on hand. Tank cars are supposed to come at intervals sufficiently close to keep the receiving tanks practically full, but in case of delay the tanks hold enough for three days' use, about 5,000 gallons being used each twenty-four hours.

In the space between the boilers in the middle of the fireroom are located two Dow pumps, size B, which supply the oil to the boilers. They have 4-inch suctions, and each is large enough to supply fuel for 4,000 h. p. of boilers. But one is used at a time, the other being held as a reserve in case of breakdown. The arrangement of pipes and valves is such that either pump can draw from either or both storage tanks, thus making a stoppage almost impossible. For the light load after midnight a small Dow pump (No. 2) is used. The pumps discharge into a vertical tank, 12 inches by 6 feet, against an air head, a steady pressure of 12 pounds being maintained automatically by means of a pump governor connected with the air head, and shutting off steam from the pump when the pressure rises.

The governor is very sensitive and the pressure kept very



SECTIONAL VIEW OF BOILER ARRANGED FOR OIL FUEL.

steady; it is registered by a gauge connected with the air head. The oil is carried to about the middle of the pressure tank, and the height is shown on a glass gauge.

There is a constant small air leak, which would soon destroy the air head if it was not compensated. To supply this loss a snifting valve on the pump is regulated so that a small quantity of air is taken in with the oil at each stroke, the amount required varying with the load. A little attention to this valve from time to time keeps the air head nearly constant. The arrangement is so nearly automatic that during the hours of heaviest load in the evening but two firemen are required to be on duty, one of whom keeps watch of the oil supply and furnaces and the other the water, and during the rest of the twenty-four hours, from midnight until 6 P. M., one man can easily care for the whole plant and have plenty of time for reading the daily papers.

Cleanliness is conspicuous, no coal or ashes being about

the floor; the boilers are painted white and stay so, and the firemen wear white uniforms.

If coal was the fuel, six or eight men would be required for heavy load. The wages saved amount to a considerable item, and probably something is saved on fuel, as coal is expensive. Besides this, the use of oil fuel adds greatly to the value as an exhibit, as the clean fireroom attracts many visitors.

From midnight to about 6 A. M. the average load is about 200 h. p., during the day from 800 to 1,000 h. p., and during heavy load in the evening about 2,500 h. p.

The oil discharge from the pressure tank is 3 inches diameter until it reaches the line of the boiler fronts, where it branches into two pipes, each 2 inches diameter, one leading aft and one forward, and each furnishing fuel for four boilers. A shallow concreted trench runs the whole length of the fireroom and drains at each end into catch pits, where any leaking can be collected. The trench is covered with light iron covers, and the oil pipe can be examined readily. Ordinarily, the leakage is insignificant, but the pits are provided in case a pipe bursts, when the escaping oil would be collected and returned to the storage tanks.

The feed-water heater is a 4,000-h. p. Webster vacuum heater, made by Warren Webster & Co., of Philadelphia. It is rectangular and has within it a series of plates set alternately so that water will descend by passing from plate to plate in a thin sheet. The water inlet is 5 feet, and water is supplied from the water company's mains at a pressure of 80 pounds.

The main exhaust rises close to the heater and has a single branch lead extending to the heater, which forms a closed trap for the steam that enters it. Cold water is admitted at the top, and as it passes downward from plate to plate it condenses the steam, which fills all the space between the plates. A partial vacuum is thus formed, in virtue of which the exhaust steam continues to enter the heater instead of passing to the air.

The steam enters at the bottom and the water, as it descends, becomes warmer and warmer until at discharge the hottest water is in contact with the hottest steam, and a high temperature of feed water is attained, in this case about 200 degrees Fahr.

Water is carried at a definite height, indicated by a glass gauge, and is maintained by means of a float, which controls a regulating valve in the supply pipe.

The quantity of exhaust steam entering the heater depends upon the vacuum, and this in turn depends upon the feed supply.

The discharge is 8 inches, and in case of accident the water company's mains can be connected to the feed pump suction and cold water supplied to the boilers.

For feeding three Dow (S. F.) pumps and one Smith-Vaile pump are used. The Smith-Vaile and one Dow are duplex, one Dow simple, and the other is a marine feed with by-pass valve.

Each boiler has an 8-inch steam pipe, and the pipes from two adjoining boilers unite in a single lead to the main steam pipe. This pipe extends along one side of the main building, with leads taken off where necessary. Traps are provided at intervals for taking off the water of condensation.

The location of machinery is not such as to render a steam loop either necessary or possible.

The plant is under the immediate care of Mr. E. C. Meier, who erected it for the Heine company and designed the arrangement for feeding the oil. Passed Assistant Engineer Hunt, U. S. N., is chief of the mechanical department of the Fair, and this plant was erected under his supervision.

It was only with great difficulty that a steam plant of any kind was obtained for the Exposition. At first the manufacturers of San Francisco refused to do anything unless the committee would agree to use only machines made on the Pacific Coast. The Exposition was projected in August and in October two boilers, one of 40 h. p. and the other 100 h. p., had been offered, but were never set up. In October Colonel Meier, president of the Heine Boiler Company, made a very liberal offer of four boilers of 1,500 h. p., which were in use in Chicago. Four others would have been offered, but the ones intended were in the hands of the receiver of a power company that had failed, and they could not then be obtained. The Climax company came forward with an offer of 1,000 h. p., but later they withdrew, and the Heine company, finding it could have the four boilers previously unavailable, added them to the other four, thus making 3,000 h. p., which constitutes the entire plant.

Destructive Effects of Electrical Currents on Subterranean Metal Pipes.*

BY I. H. FARNHAM.*

After describing experiments showing the manner in which pipes laid in damp ground are corroded by electrolysis, Mr. Farnham gives the result of his investigations of the effect on telephone cables in Boston of the ground currents of the West End Street Railway. Measurements were made between the cables at all manholes and the earth near the cables, and it was found that the negative pole of the generator being connected with the trolley line, within a radius of about 2,000 feet from the Albany street power house the cables were negative to the earth, ranging from zero to two volts; outside of this neutral line they were positive to earth, ranging from zero to 12 volts, until a point near the East

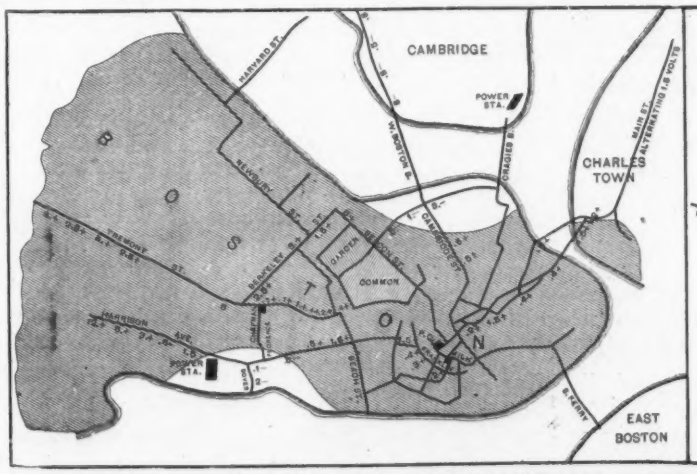


FIG. 1.—NEGATIVE POLE OF GENERATOR TO LINE.

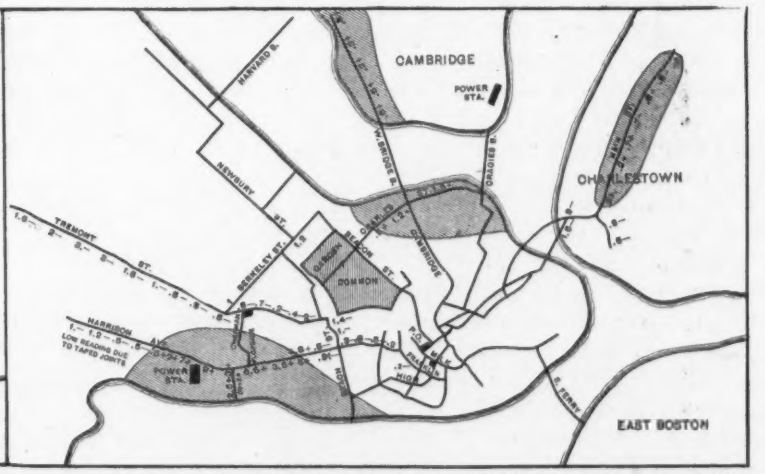


FIG. 2.—POSITIVE POLE OF GENERATOR TO LINE.

* Abstract of a paper read before the New York meeting of the Institute of Electrical Engineers, April 18, 1894.

Cambridge power house station, when they again passed a neutral line and became more and more positive as that power house was approached. From the data of measurements, maps, Figs. 1 and 2, were plotted showing the voltage between the cables and the earth throughout all the section of the city, the hatched portions being where the cables were found positive to earth and denoted "danger territory."

With the negative pole of the generator to the trolley, Fig. 3 shows the passage of the current from the generator to the rails, and the passage of a portion of the current from the rails to the cables within the neutral or zero line, and from cables to rails outside of this zero line. The danger of elec-

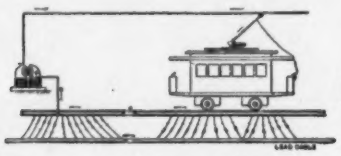


FIG. 3.—NEGATIVE POLE TO LINE.

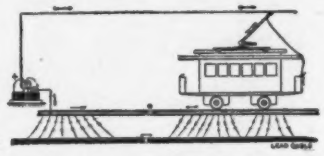


FIG. 4.—POSITIVE POLE TO LINE.

trolysis is only where the current leaves the cable or pipe through the moist earth, hence the danger district was at this time outside of the zero, or neutral line, as shown both on the map, Fig. 1, and Fig. 3.

Fig. 2 is a map showing the condition when the positive pole of the generator was connected to the trolley line, the shaded portion again showing the danger district, corresponding to the white, or safe, districts in Fig. 1, the only variation being that the neutral or zero line was thrown out a little further from the Albany street power house than it was before. It was also noted that the cables near the power house which had been from one to two volts negative to earth before the change of currents were now from one to nine volts positive to earth.

Fig. 4 is a representation of the current when flowing from the positive pole to line, and it will be readily understood that the electrolytic action will be thus confined to the territory comparatively near the power house, where current is leaving the cables to reach the negative or rail side of the dynamo.

Among the proposed and applied remedies for preventing the destruction of the cables were the following:

First—The removal of the cables from the wet bottoms and sides of the so-called manholes. It was found, however, very difficult to place and retain the cables free from the wet sides, and the action of the mouth of the ducts would nevertheless continue.

Second—The cables were connected to ground plates in the manholes with the idea of transferring the electrolytic action to these plates, but although many ground plates giving a surface of several square feet each were connected with the cables over large portions of the city, it was found that nearly the same pressure existed as before.

Third—Prof. Elihu Thomson suggested placing motor generators along the line to be operated by the railway current and automatically regulated to generate a voltage equal but opposite to that existing between the cable and ground.

Fourth—Insulating the cables and pipes from the earth was proposed, but was found impracticable.

Fifth—Breaking the metallic continuity of the cable sheath and pipes was proposed, but as the severe action was found in comparatively isolated spots, it follows that any system of breaking the metallic continuity would have to be studied with regard to the entire complicated system of pipes, cables and rails ramifying through the streets of the city.

Sixth—It was suggested that the railway current might be so frequently alternated as to possibly prevent serious action on the pipes and cables, the oxygen liberated by the current being dispersed by the reversal before it could attack the metal. Good results were derived from an experiment conducted on these lines with frequent reversals, but with 24-hour periods it was found that no good was derived, and it was concluded that it would be impossible to reverse the heavy railroad currents at frequent enough intervals.

Seventh—Mr. Fred. S. Pearson suggested that the positive pole of the generator should be connected to the line and also that large bare conductors radiating from the power station into the danger district should be laid and connected at frequent intervals to such cables and pipes as were in danger. Both of these suggestions were adopted and with the most successful results.

Mr. Farnham gives the following as the conclusions resulting from his investigations:

First—All single trolley railways employing the rails as a portion of the circuit cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.

Second—A fraction of a volt difference of potential between pipes and the damp earth surrounding them is sufficient to induce the action.

Third—Bonding of rails, or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.

Fourth—Insulating pipes sufficiently to prevent the trouble is impracticable.

Fifth—Breaking the metallic continuity of pipes at sufficiently frequent intervals is impracticable.

Sixth—It is advisable to connect the positive pole of the dynamo to the trolley lines.

Seventh—A large conductor extending from the grounded side of the dynamo entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.

Eighth—It is better to use a separate conductor for each set of pipes to be protected.

Ninth—Connection only at the power station, to water or gas pipes, will not ensure their safety.

Tenth—Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.

Eleventh—Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made as the measurements indicate.

Hamburg Electric Tramway.

(From Our Own Correspondent.)

The official inauguration of the electric tramway in Hamburg, equipped on the Thomson-Houston system by the Union Elektricitaets-Gesellschaft, of Berlin, took place on the 29th of March, and was attended by a large number of gentlemen connected with the tramway interests of that country—directors, engineers and managers, besides the representatives of several important municipal bodies.

The programme was as follows: Starting at 10 A. M. from the Dammthor Railway station, the party proceeded upon a round of inspection on several electric cars on the Ringbahn section and out to Falkenried, the depot of the line; at noon the harbor was visited, where a steamer was in waiting to convey the company round the quays; finally the power station, located in the Poststrasse, was thoroughly inspected. Unanimous satisfaction was expressed with all that was seen. The guests, numbering about one hundred, were afterward entertained at dinner by the Union Elektricitaets-Gesellschaft.

The total length of the road, when completed, will be between eleven and twelve miles, and the number of motor cars 42, 32 for regular service and 10 in reserve to meet

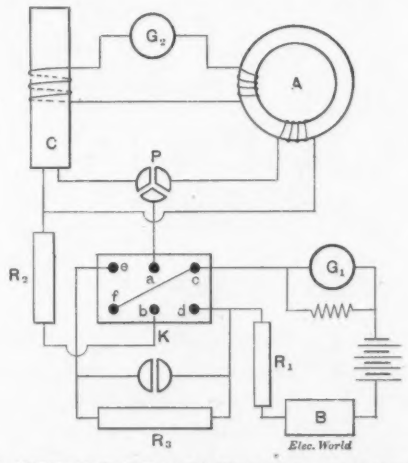
extra heavy traffic requirements on holidays, etc. The Ringbahn section of the system, covering some five miles of track, with 16 motor cars, has been in regular operation since the first week in March, and the rest of the line is expected to be in running condition by about the middle of this month. The generating plant is contained in the municipal central station, the low voltage lighting current being taken up by Schuckert continuous current converters and delivered at a potential of 500 volts to the tramway circuit. In addition, there is installed as reserve set a Thomson-Houston 100-kw. railway generator, driven by a McIntosh & Seymour tandem compound condensing engine. The trolley wire is run at a height of 18 to 20 feet above the track, attached to brackets on steel poles erected along the road, or else run on the cross suspension method. At such locations where the streets, by reason of their narrowness, or the conditions of traffic, preclude the use of poles, rosettes fixed to the houses on either side of the street, as in Bremen, are employed. Each car is equipped with 1 15-h. p. motor, controller, lightning arrester, etc., and is lighted by 5 16-c. p. incandescent lamps. At points where telephone wires cross the tramway, neat wooden moulding is run along the top of the trolley wire to prevent the telephone wires, in case of their falling by any means, coming in contact with the former. This method has been in use in Bremen for some time and proved satisfactory.

Magnetic Qualities of Iron.*

BY J. A. EWING AND HELEN G. KLAASSEN.

The experiments to be described in this paper deal mainly with the cyclic effects of magnetizing force. They are intended to contribute some additions to existing data, to answer one or two specific questions, and to exemplify one or more novel methods of experimental inquiry.

We have devised and used throughout all these experiments a method which, while requiring only one current and one magnetizing coil, retains the advantage that each point in the cycle is reached by a single step from the end of the cycle.



METHOD TO DETERMINE MAGNETIC QUALITIES OF IRON.

The diagram shows the arrangement used.

The magnetizing current passes from the battery through the adjustable resistance R_1 and the galvanometer G_1 to a key, K, and thence through the resistance R_2 to a two-way plug P, which allows it to be sent either into the magnetizing coil of the ring A, which is the sample under test, or into the primary of a special induction coil, C, which is used for standardizing the ballistic galvanometer. A and C each have a secondary coil; the two secondaries are kept in series with one another, and their circuit is completed through the ballistic galvanometer G_2. A Kelvin balance, B, which is short circuited when it is not required, serves to determine the constant of the current galvanometer G_1. The key K is a rocker, working in mercury cups, which, when rocked to the left, connects a with e and b with f, and, when rocked to the right, connects a with c and b with d. In the latter position of the key the full strength of the magnetizing current is in action, and hence if the plug P is set so as to send the current into A, the sample is magnetized to a degree which represents one extremity of a magnetic cycle. Between the cups e and d of the rocking key are a short circuit plug and also an adjustable resistance, R_3. When this short circuit plug is inserted, the key K is simply a reversing key, and then, when rocked to the left, it reverses the magnetization of the ring, carrying it at once to the opposite end of the cycle. But when, instead of a short circuit between c and d, there is a resistance, the rocking of the key to the left applies to the sample a magnetizing current opposite in sign to the primitive current, but less than it in amount, and consequently carries its magnetism to the end of the cycle, but to a point which falls short of the end by an amount depending on the magnetism of the resistance R_3. The peculiarity of the method is that, by a single movement of the key, the magnetizing current is at once reduced in amount and reversed in sign.* By giving R_3 a series of values, each movement of the key to the left determines a new point on the curve, while each movement to the right brings back the magnetization to its extreme value. In this way as many points are found as may be required to define that part of the curve which lies between the zero of magnetizing force and its extreme negative value. To find points lying between the positive extreme and the zero of magnetizing force, a different process is adopted. The key is kept to the left, and a sudden reduction of the current (without change of sign) is effected by withdrawing a plug from the resistance box R_2. This gives a point in the first quadrant of the descending curve, and a series of such points are found by selecting successive values of R_2, the magnetization of the sample being, however, restored to its initial full value before each such step.

*A portion of a paper recently read before the Royal Society.

*Since this description was written, a paper has been communicated to the Royal Society by Dr. John Hopkinson and Messrs. Lydall and Wilson, in which ballistic experiments are described where the method was essentially the same as that used by us. A single movement of a key reversed the magnetizing current and introduced resistance. (Roy. Soc. Proc., vol. LIII., p. 352.)

Aurora and the Telegraph Wires.

The following query has been addressed by Mr. Preece to the editor of "The Times":

"Sir: There was an extremely brilliant display of aurora between 10 and 10:45 P. M. on Friday, the 30th ult. It was accompanied, as usual, by very strong earth currents on all telegraph lines. But at 10:20 P. M., when all the telegraph circuits were idle, a peculiar frizzling and bubbling noise was heard upon a telephone inserted upon a long Irish wire at Llanfairpwll in Anglesey. At 2 A. M. on Saturday, the 31st ult., 'twangs' were heard, as if a stretched wire had been struck. These were followed by a kind of whistling sound. Were these signals from space, or mere disturbances of atmospheric electricity?"

A Well Deserved Sentence.

An English electric belt quack doctor, who was said to be earning (?) $15,000 to $20,000 per year, has just been sentenced to five years' imprisonment. What a blessing it would be if we had such courts and laws in this country.

Electric Plows.

The firm of Siemens & Halske is said to be experimenting with an electric plow on the estate of Mr. Siemens.

Rope Driving—XI.*

BY J. J. FLATHER.

As it has been previously noted, it is desirable in all cases of rope transmission to so arrange the drive that the slack side of the rope shall be on the upper part of the pulley, thus increasing the arc of contact, as the two sides will then approach each other when in motion.

In order that the desired tensions, T_1 and T_2, shall be attained in the two parts of a rope, the deflections or sag must be of predetermined values. The centre line of the rope will lie in a curve, which may be determined with no appreciable error by assuming the rope to have no elasticity and to be of constant cross-section, under which condition the curve will be that known as the catenary, the transcendental equation of which is

$$y = \frac{c}{2}\left(\varepsilon^{\frac{x}{c}} + \varepsilon^{-\frac{x}{c}}\right).$$

Let the form of curve in which the rope hangs be represented by $P\ O'\ P'$ (Fig. 33), in which O' is the lowest point

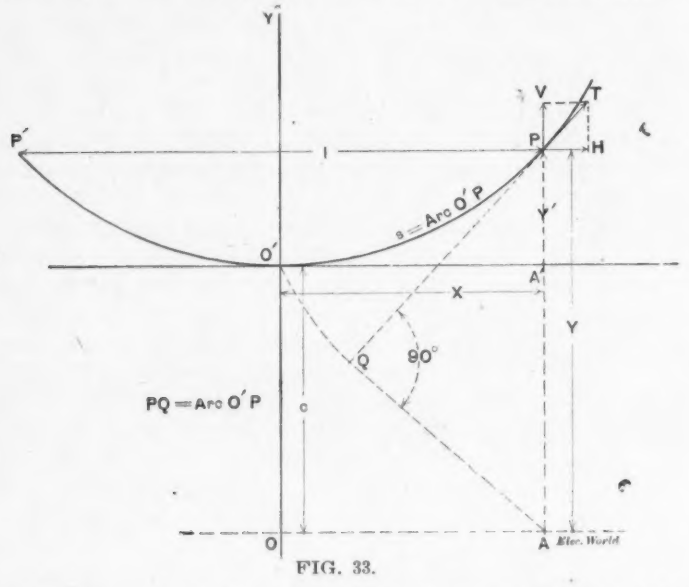


FIG. 33.

of the rope. Take O' as the origin of co-ordinates, and let $x = O'\ A'$, and $y' = A'\ P$ be the abscissa and ordinate of any point P in the curve, and let l be the distance between the points of support.

Since we have assumed the rope to be perfectly inelastic, the tension at any point of the curve must be in the direction of the rope. Let T be the stress in the rope at P, the vertical and horizontal components of which are represented by V and H respectively. Assume the length of curve $O'\ P = s$. Since the weight of a unit length of rope $= w$, the vertical component of the tension T is evidently equal to one-half the weight of the rope between the points P and P', or $V = {}^1/_2\ w\ P\ O'\ P' = w\ s$. To determine the length of curve, produce the tangent through the point P and rectify the curve $O'\ P$ on this tangent, making $s = P\ Q$. Erect a perpendicular to $P\ Q$ at the point Q, meeting the vertical from P at A; then will $O\ A$ drawn through A parallel to $O'\ A'$ be the directrix to the catenary and $Q\ A$ will equal $A\ A' = C$.† Hence

$$\overline{P\ Q}^2 = \overline{P\ A}^2 - \overline{Q\ A}^2,$$

$$s^2 = (c + y')^2 - c^2 \therefore s = \sqrt{(y')^2 + 2\ c\ y'}\ ;\ \text{therefore}$$

$$V = w\ s = w\ \sqrt{(y')^2 + 2\ c\ y'}.$$

At the vertex O the tension is horizontal and equal to the weight of a length, c, of the rope; but this tension is the same as the horizontal component at the point P; hence $H = w\ c$. Since $T = \sqrt{V^2 + H^2}$, we obtain the following value for the tension in the rope:

$$T = w\ \sqrt{y'^2 + 2\ c\ y' + c^2} = w\ (c + y').$$

† For geometry of this curve see "The Funicular Polygon" in Bowser's "Analytic Mechanics," p. 216 et seq.; also Price's "Mechanics," vol. I.

In order to determine the parameter c, let the equation of the curve $y = \frac{c}{2}\left(\varepsilon^{\frac{x}{c}} + \varepsilon^{-\frac{x}{c}}\right)$ be developed in the following series:

$$y + \frac{c}{2}\left(1 + \frac{x}{c} + \frac{x^2}{1.2\ c^2} + \frac{x^3}{1.2,3\ c^3} \cdots\cdots + \frac{2}{x} - 1 + \frac{x^2}{1.2\ c^2} - \frac{x^3}{1.2\ 3\ c^3} + \cdots\cdots\right).$$

Since the character of the curve is such that the quotient $\frac{x}{c}$ is a proper fraction, the series will be converging; stopping at the third member as giving sufficient accuracy, we have $y = \frac{c}{2}\left(2 + \frac{x^2}{c^2}\right) = c + \frac{x^2}{2c}$; therefore

$$x^2 = (c\ y - c).$$

Substituting the value of $y = y' + c$ in this equation, we obtain $x^2 = 2\ c\ y'$, which is the equation of a parabola re-

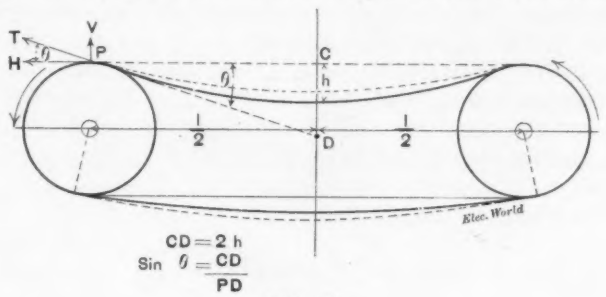


FIG. 34.

ferred to its axis and the tangent to its vertex. Now let $\frac{l}{2}$ (Fig. 34) equal the half distance between supports $= x$; and $h =$ sag of the rope $= y'$; then from the previous equation we obtain $\left(\frac{l}{2}\right)^2 = 2\ c\ h$; hence the parameter, c, $= \frac{l^2}{8\ h}$. Substituting this value of c in the equation for the tension T previously obtained, we have

$$T = w\left(\frac{l^2}{8\ h} + h\right),$$

in which w equals the weight of a unit length of rope $= 0.32\ d^2$: that is, the tension at any point in the rope is equal to the weight of a portion equivalent in length to the parameter plus the ordinate y' of the point. From this equation we may obtain the sag of the driving or driven portions of the rope by substituting for T the values of T_1 and T_2—the deflections corresponding to which may be represented by h_1 and h_2 (Fig. 34). T_1 will evidently be constant and equal to $200\ d^2$ if our preconceived conditions are maintained, but the value of T_2 will be variable, increasing with the speed.

Practically it will be impossible to maintain a constant tension in the rope, so that the amount of sag obtained by calculation is liable to vary with the conditions of service. The tension may, however, be approximately determined by the deflection. Assuming the distance between supporting points of the rope equal to the distance between centres of pulleys and solving for h, we obtain

$$h_1 = \frac{1}{2}\frac{T_1}{w} \pm \frac{1}{2}\sqrt{\frac{T_1^2}{w^2} - \frac{l^2}{2}},$$

$$h^2 = \frac{1}{2}\frac{T_2}{w} \pm \frac{1}{2}\sqrt{\frac{T_2^2}{w} - \frac{l^2}{2}}.$$

The positive and negative signs before the radical in these equations indicate two values for h, the lesser of which only is to be used. As pointed out by Reuleaux, between the two lies a value $h = \frac{1}{2}\frac{T}{w}$, which is obtained when the quantity under the radical $= 0$; that is, when $T = \frac{w\ l}{\sqrt{2}}$.

This deflection is interesting, as it denotes the minimum stress which may exist in the rope.

Since the sum of the tensions increases with the speed the sag of the rope when at rest is not directly obtainable from the previous values of h_1 and h_2.

The tension necessary for adhesion, which constitutes a part of the stress, T_1, is dependent upon the speed at which the rope is intended to be run, so that in order to determine the sag h_0 when at rest for a given maximum tension T_1 the initial tension must be obtained for any given speed, and this value substituted in the general formula

$$h = \frac{T}{2\,w} \pm \frac{1}{2}\sqrt{\frac{T^2}{w} - \frac{l^2}{2}}.$$

Assuming the tension on the tight side of the rope to be made up of three parts, namely, the driving force, P, the centrifugal force, F_0, and the tension, T_3, necessary to balance the strain for adhesion, we obtain $T_1 = P + F_0 + T_3$; in like manner the tension on the slack side of the rope may be assumed to be produced by the strain necessary for adhesion, plus the strain due to centrifugal force, that is: $T_2 = T_3 + F_0$.

It is evident that if the normal tension T_1 be diminished by the centrifugal force the remaining stress will be equal to the tension necessary for adhesion plus the driving force; hence if we obtain the value of the ratio $\frac{T_1}{T_2}$ from $\varepsilon^{\phi\alpha}$, in which the stress due to centrifugal force is neglected, we shall have in T_2 the initial tension necessary for adhesion or $T_2 = T_3$. If T_1 is assumed to be constant, then T_3 will be constant for a given coefficient of friction and arc of contact; therefore $\frac{T_1 + T_3}{2}$ will equal the tension in the rope when the latter is at rest.

The following simpler method for obtaining the sag, though less exact, is sufficiently accurate for any practical case that may arise, for it must be borne in mind that any theoretical calculation for the deflection of a running rope can at best be only an approximation, as it is exact only when the rope is running at its normal speed, transmitting its full load and strained to its normal tension. Let l be the distance between two shafts which are at the same level (Fig. 35), and let h be the deflection of the rope; also

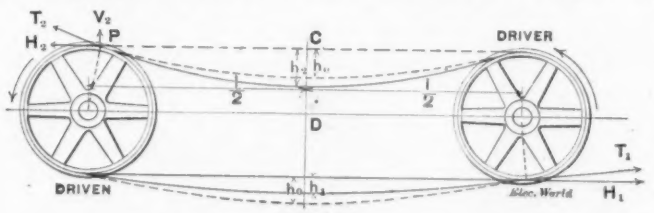


FIG. 35.

let $C\,P\,D = \theta$ be the inclination of the rope at P, from which

$$\sin\theta = \frac{C\,D}{P\,D} = \frac{2\,h}{\sqrt{\left(\frac{l}{2}\right)^2 + (2\,h)^2}} = \frac{4\,h}{\sqrt{l^2 + (4\,h)^2}},$$

and hence, since V is the vertical component of the tension T in the rope and equal to $\frac{W}{2}$, where W is the weight of rope between supports, we shall have

$$T = \frac{V}{\sin\alpha} = \frac{W}{8\,h}\sqrt{l^2 + (4\,h)^2} = W\sqrt{\frac{l^2}{64\,h^2} + \frac{1}{4}}\,h^2.$$

As h is small compared to l, we may neglect $\frac{1}{4}\,h^2$, then if we assume the length of rope to be equal to the distance between the shafts, we shall have, approximately,

$T = \frac{W\,l}{8\,h} = \frac{w\,l^2}{8\,h}$ where $w\,l = W$; hence the sag of the rope at the centre will be $h = \frac{w\,l^2}{8\,T}$, in which $w = 0.32\,d^2$.

TABLE I.—DEFLECTION OF ROPE.

Calculated from $h = \frac{w\,l^2}{8\,T}$.

Distance between pulleys in feet.	Deflection in feet in slack side of rope when $T_2 = T_1 - P =$ 86 d^2 | 91 d^2 | 100 d^2 | 112 d^2 Corresponding to velocity in feet per minute of: 2000	3000	4000	5000	Deflection in tight side of rope when $T_1 =$ 200 d^2 pounds.	Deflection in both sides of the rope when initial tension $T_0 =$ 141 d^2
40	0.74	0.70	0.64	0.57	0.32	.45
60	1.67	1.58	1.44	1.28	0.72	1.02
80	2.97	2.81	2.56	2.28	1.28	1.82
100	4.65	4.40	4.00	3.57	2.00	2.84
120	6.70	6.33	5.76	5.14	2.88	4.10
140	9.12	8.61	7.84	7.00	3.82	5.58
160	11.90	11.25	10.24	9.14	5.12	7.27

From this formula the following table has been computed and the curves plotted, as shown in Fig. 36, T_1 being

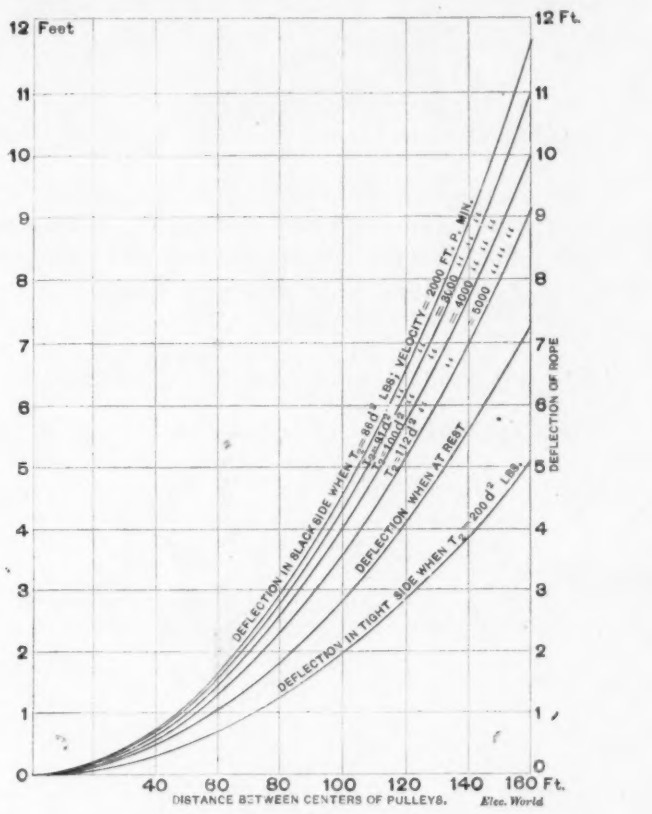

12 Feet
12 Ft.
11
10
9
8
7
6
5
4
3
2
1
0
DEFLECTION IN BLACK SIDE WHEN T₂ = 86 d² LBS.; VELOCITY = 2000 FT. P. MIN.
T₂ = 91 d² " " = 3000 " " "
T₂ = 100 d² " " = 4000 " " "
T₂ = 112 d² " " = 5000 " " "
DEFLECTION WHEN AT REST
DEFLECTION IN TIGHT SIDE WHEN T₁ = 200 d² LBS.
DEFLECTION OF ROPE
40 60 80 100 120 140 160 Ft.
DISTANCE BETWEEN CENTERS OF PULLEYS.
Elec. World

FIG. 36.

assumed as constant and equal to 200 d^2 pounds. The tension T_2, which varies with the speed, has been separately determined for the several cases considered from

$$\frac{T_1}{T_2} = \varepsilon^{\phi\alpha}\,(1 - Z),$$

in which the coefficient of friction, φ, $= 0.31$ and $\alpha = 2.88$; hence

$$\log\frac{T_1}{T_2} = 0.4343 \times 0.9\,(1 - Z).$$

The deflection on the tight side will then be $h_1 = \frac{0.32\,d^2}{8\,T_1}$ $= \frac{0.32\,d^2\,l^2}{8 \times 200\,d^2} = 0.0002\,l^2$; and on the slack side $h_2 = \frac{0.04\,l^2}{T_2}$, in which T_2 has the values given in the table.

As previously pointed out, the initial tension in the rope when at rest may be obtained by neglecting F_0, in which case we have $\log\frac{T_1}{T_2} = 0.4343\;\varphi\;\alpha$, from which we find $\frac{T_1}{T_2} = 2.46$, or $T_2 = 82\,d^2$; and since $T_2 = T_3$, when there is no centrifugal force acting, the initial tension, which we may call T_0, will equal

$$\frac{T_1 + T_2}{2} = \frac{200\,d^2 + 82\,d^2}{2};$$

hence $T_0 = 141\,d^2$. From this we may obtain the deflection when the rope is at rest, as noted in the last column

of Table I., which has been computed from $h_0 = \frac{0.32\ d^2\ l^2}{8\ T_0} = 0.000284\ l^2$, where l is the distance in feet between centres.

To draw the curve of the rope in order to determine the space it will occupy, assume it to hang in a parabola with

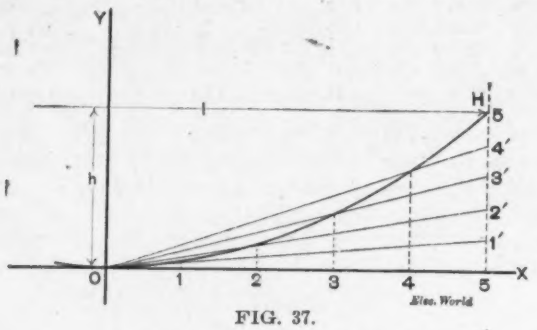


FIG. 37.

origin at vertex and lay off the X and Y axes, as in Fig. 37. Let $o\ x = \frac{1}{2}\ l = \frac{1}{2}$ distance between points of suspension of the rope, and let $5\ H = h$ equal the sag of rope. Divide $5\ H$ into a convenient number of equal parts; also divide $o\ x$ into the same number of equal parts; erect perpendiculars from the points of division 1, 2, 3....and join 1', 2', 3'.... with the origin o. The curve drawn through the points of intersection will represent one branch of the parabola desired.

Where the pulleys are placed at different heights we have an inclined transmission, and the curve in such cases is unsymmetrical, as in Fig. 38.*

This curve is best solved by an approximation similar to

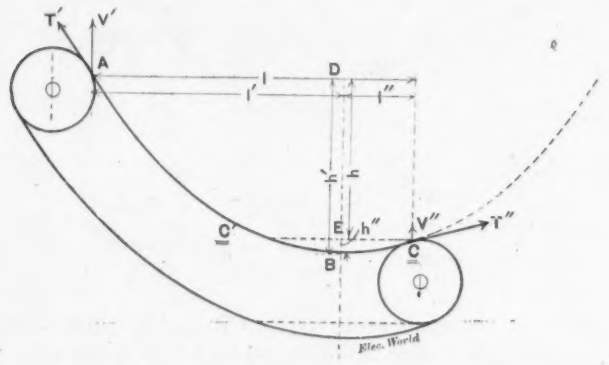


FIG. 38.

that already given. It will be noticed that the curve of the rope $A\ B\ C$ is made up of two unequal parts, $A\ B$ and $B\ C$, whose horizontal projections are l' and l'' and their corresponding deflections h' and h''. The given difference in height between the points of support of the rope is $E\ D = h = h' - h''$, and their known horizontal distance is $l = l' + l''$. From the preceding formula for the deflection we have $h' = \frac{w\ l'^3}{8\ T''} = \beta\ l'^2$ and $h'' = \frac{w\ l''^2}{8\ T''} = \beta\ l''^2$, in which β is taken as a coefficient depending upon the value of the tension in the rope $= \frac{0.32}{8\ T''}$.

Since $h = h' - h''$ and $l = l' + l''$, we have

$$h = \beta\ (l'^2 - l''^2) = \beta\ (l' - l'')\ (l' + l'') = \beta\ l\ (l' - l'');$$

therefore $l' - l'' = \frac{h}{\beta\ l}$. But $l' = l - l''$ and $l'' = l - l'$; hence $2\ \beta\ l\ l' - \beta\ l^2 = h$, and the required distance $l' = \frac{h + \beta\ l^2}{2\ \beta\ l}$; in the same way $l'' = \frac{\beta\ l^2 - h}{2\ \beta\ l}$, and the deflections are

$$h' = \beta \left(\frac{h + \beta\ l^2}{2\ \beta\ l}\right)^2 \text{ and } h'' = \beta \left(\frac{\beta\ l^2 - h}{2\ \beta\ l}\right)^2,$$

in each of which equations β has a separate value, depending upon the tension in the rope. It is evident that the tension T' at A will be greater than that at C on account of the greater weight of rope lying in the upper branch of the parabola.

If T'' is known, the lesser tension, T', can be determined by assuming the length of the rope to be the same as if the points A and C (Fig. 39) were at the same height and l feet apart. From previous considerations it is seen that the tension at any point of the rope in a parabola is equal to the weight of rope equivalent in length to the parameter c added to the ordinate of the point; hence if h'' equals the ordinate of $C = h' - h$ (Fig. 39), we shall have

$$T'' = w\ (c + h''), \text{ and}$$
$$T' = w\ (c + h').$$

Since $c = \frac{l^2}{8\ h'}$

$$T'' = w \left(\frac{l^2}{8\ h'} + h'\right) \text{ and } T' = w \left(\frac{l^2}{8\ h'} + h''\right),$$

therefore $T'' - w\ h' = T' - w\ h''$; substituting for h' its value, $h + h''$, there is obtained

$$T'' = T' - w\ h.$$

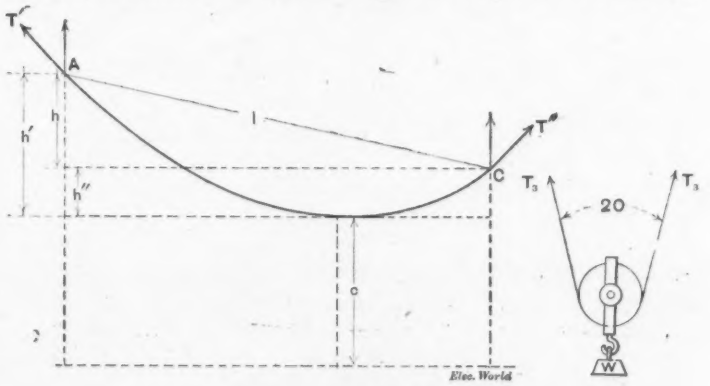
When a tension carriage is used, the necessary weight can be ascertained from the formula for back tension, $T_2 = T_1 + F_0$; if we assume $F_0 = 0$, we shall have the initial tension necessary for adhesion equal to the tension in slack side of rope—that is, $T_2 = T_3$—but $T_2 = \frac{T_1}{2.46}$ (from $\log \frac{T_1}{T_2} = 0.434\ \varphi\ \alpha$, neglecting effect of centrifugal force); therefore the

initial tension in the rope is $T_3 = \frac{T_1}{2.46} = \frac{200\ d^2}{2.46}$.

When diameter of rope =

⅝	inch	the	initial	tension =	31½	pounds.
¾	"	"	"	"	45½	"
1	"	"	"	"	82	"
1¼	"	"	"	"	127	"
1½	"	"	"	"	184	"
1¾	"	"	"	"	250	"
2	"	"	"	"	325	"

With a horizontal arrangement of ropes, part of this tension is provided for by the weight of rope itself, but with a vertical drive the weight of rope tends to reduce the initial tension, therefore the actual weight to be placed on the ten-



FIGS. 39 AND 40.

sion pulley will depend upon the arrangement of drive, and must be calculated for each particular case. It is to be noted that with a vertical tension carriage the weight of carriage and sheave must be considered as a portion of the weight producing tension in the rope.

If w equals the total weight necessary to maintain the tension T_3 in each part of the rope leading off from the tension pulley, then when these two portions are parallel, we shall have $W = 2\ T_3$; but if the rope leads from the tension pulley so that it includes an angle $2\ \theta$ between its sides, as shown in Fig. 40, then the weight W will be less, and may be found from $W = 2\ T_3 \cos \theta$.

(To be continued.)

*Weisbach, vol. III., p. 243.

THE ELECTRICAL WORLD'S DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS BY CARL HERING

ELEC. WORLD, N.Y.

ELECTRO-PHYSICS.

Thermo-Electric Cells.—In a note in the Lond. "Elec. Eng.," April 6, some data regarding such cells by Mr. Gockel are given; he confirms the statement that the worst conductors are thermo-electrically the most active and that some show a maximum thermo-electric force at the concentration of maximum conductivity.

Electromagnetic Rotation.—According to the Lond. "Elec. Rev.," April 6, Humburg concludes that the electromagnetic rotation is independent of dissociation; that is, that electrolytic dissociation has no appreciable effect on magnetic rotation.

Conductivity of Solutions.—Some figures by Mr. Holland are given in the Lond. "Elec. Eng.," April 6, for the change of conducticity of a solution by the addition of a non-electrolyte.

Discharges in Gases.—In the Lond. "Elec. Rev.," April 6, there is a short review of a Physical Society paper by Mr. Baly on the behavior of gases under the influence of an electrical discharge; also an article by Mr. Taylor on the "Electrification of Gases and Liquids"; also a brief summary of the results of Dr. Lenard, obtained from his experiments on "Cathodic Rays in Gases."

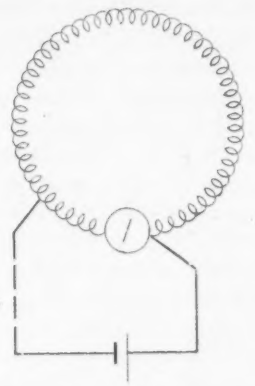
MAGNETISM.

Magnetic Qualities of Iron.—A Royal Society paper by Prof. Ewing and Miss Klaassen is reprinted in the Lond. "Elec.," April 6. The description of the method is given in full in another column of the present issue. A large number of hysteresis curves are given; a curious feature is shown in the relation of the successive cycles to one another, which, however, is of quite general occurrence; the extremity of each cycle lies outside of the rising curve of the immediately higher cycle, provided there is no very great difference in their range of magnetism; it does not happen for the lowest cycle; the first two tests were made with iron wire rings, the results showing how small the loss of energy through hysteresis becomes when the limits of magnetization or of magnetic force are restricted within certain values; the next three tests were made with sheet iron, for which some curves are given; the article is to be continued. In the second part the heating effects of the reversals were investigated by securing a thermo-balance between two equal rings, and was intended to answer the question whether the heating in the core of a transformer is the same when the transformer is loaded as when it is not, the conclusions being that it is the same. The paper is abstracted by Mr. Appleyard in the Lond. "Elec. Rev.," April 6.

Permeability of Oxygen.—Mr. Hennig's researches are described briefly in the Lond. "Elec. Eng.," April 6; he determined the relative permeability of oxygen and air by Toepler's method, which is briefly described; his result is 0.096×10^{6} for the difference of the permeabilities reduced to one atmosphere pressure, a result which agrees moderately well with four other determinations which are given.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Universal Galvanometer Shunt.—The Lond. "Elec.," April 6, discusses the arrangement of Ayrton and Mather described in their paper, published in these columns last week.



UNIVERSAL GALVANOMETER SHUNT.

The accompanying cut is given as showing the principle much more clearly, the contact with the permanent shunt being moved round to different parts of it; attention is called to the fact that the main current must be kept constant; an objection to the system is that the definite multiplying powers are not marked as with ordinary shunts. It is remarked that it is not half the main current which passes through the galvanometer if half the wire is intercepted between the battery contacts; the whole of the shunt should theoretically have an infinite resistance as compared with the galvanometer resistance, and the external resistance must be practically infinite as compared with that of the shunt; it is thought that such shunt boxes would not have a very extensive use, partially because of the want of absolute multiplying power, such as 1, 10, 100, etc.; they could be used only with galvanometers of very low resistance, and there would be a doubt about the limits of error when it is desired to measure the main current. An addendum to the paper, published in The Electrical World last week, appears in the same issue and in the Lond. "Elec. Eng." They discuss mathematically whether the change in the resistance of the current is greater with this method or with the ordinary method, and they show that whatever be the values the change will be less in their method; also that if the resistance of the shunt is exactly equal to the galvanometer resistance multiplied by the shunt power, there will be no change whatever produced in the resistance of the circuit. In the discussion Mr. Higgins announced that he had used this system for twenty years; Mr. Crompton suggested that

it would be simpler to use a graduated wire and shunt it, thus making it a potentiometer method; Prof. Ayrton replied that the graduated wire would not answer with galvanometers of a high resistance.

The Mho.—The "Elek. Zeit.," March 29, contains an article by Mr. Teichmueller, an engineer of a well-known German wire company, in which he discusses the various ways in which the conductivity of metals, particularly that of copper, is expressed, pointing out the great want of uniformity; he gives the various figures for pure copper as obtained by different experimenters, showing the difference, and therefore the objection to using pure copper as a basis; it would, besides, introduce a new unit; he discusses the various methods in use for indicating conductivity and points out the objections to each of them, one of the least objectionable being the reference of copper to mercury, and the most objectionable to base conductivities on that of pure copper; he urges that no new unit should be adopted that is not based on the absolute system; he then discusses the term "mho," to which he makes no objections, and which he seems to advocate, urging that before its introduction its use should be clearly understood; specific resistance given in mikrohm centimetres correspond to megamho centimetres, a name which he hopes will soon come into use; numbers given in megamho centimetres and in mhos per metre per square millimetre differ only by a factor of 100, so that no errors need be feared, which he shows by giving a number of corresponding values; 1.6183 mikrohm centimetres (international) are equal to 0.616 megamho centimetres, or to 61.6 mhos per metre per square millimetre. In conclusion, he gives a table of 17 different values in each of six columns, giving for each conductivity the corresponding values in megamhos (international), the per cent. value in terms of chemically pure copper according to Matthiessen, according to Siemens and according to Lagarde, the conductivity in relation to mercury and the corresponding specific resistance in mikrohm centimetres; 100 per cent Lagarde corresponds to 103.9 Matthiessen, 104.0 Siemens, 0.625 microhm centimetres at 0° C., 61.3 as compared with mercury and 1.534 mikrohm centimetres; for 100 per cent. Matthiessen the figures are 96.3 Lagarde, 100.1 Siemens, 0.628, 59.05 and 1.953.

Photometry.—A lecture by Captain Abney is abstracted briefly in the Lond. "Elec. Rev.," April 6; nothing new is given; he recommends the arc as a standard, as it is a light of the same kind; a square inch of the crater would be equal to 284,000 candles; he remarks that at any one moment there is about a millionth of a grain of carbon in a candle flame.

Nickel-Plated Instruments.—Dr. Ebling, of the German Imperial Institute, according to an article in the "Elek. Zeit.," March 29, and an abstract in the Lond. "Elec.," April 6, calls attention to the danger of nickel plating delicate electromagnetic instruments on account of the magnetism of the nickel; he finds that nickel plating, even when so thin as to be quite transparent, has a very marked magnetic effect.

DYNAMOS AND MOTORS.

Magnet Winding.—In a paper of Prof. Ayrton he states that the resistance of a coil of wire occupying a given form and volume is proportional to the square of the number of turns; and that this is absolutely true, either when the thickness of the insulating covering is negligible compared with the thickness of the copper, or when the ratio of thickness of the insulating coating to the diameter of the copper is constant for each gauge of wire. Examples are given in a Physical Society paper of galvanometers published in the "Phil. Mag.," July, 1890, where some other cases are given in which the power is five halves instead of two. (The law is given in connection with galvanometers, but there appears to be no reason why it does not apply also to magnet coils.)

Theory of Alternating Current Motors.—The "Elek. Zeit.," March 29, contains an article by Dr. Behn-Eschenburg, which is supplementary to his former article, in which he gives an approximate theory, neglecting certain factors; in the present mathematical paper he gives the exact calculation, together with results from which those formulas are deduced; the article is quite long, and is almost entirely of a mathematical nature.

TRANSFORMERS.

Heating of Transformers.—In some researches by Prof. Ewing and Miss Klaassen, described by Mr. Appleyard in the Lond. "Elec. Rev.," April 6, they investigate the question whether the heating in the core is the same when the transformer is loaded as it is when it is not loaded, the conclusions being that the heating is the same in both cases. Further references to this article are given under the heading "Magnetism."

ARC AND INCANDESCENT LIGHTS.

Origin of Incandescent Lamps.—"Ind. and Iron," April 6, publishes a letter by Mr. Maxim which is interesting reading; he claims to have discovered the process of treating the filaments in hydrocarbon vapors, but lost the U. S. patent by a fraud, and that it was due to his testimony that the patent became public property.

Illumination.—Dr. Fleming, in a recent lecture, states that bright moonlight is about one-fiftieth of a candle-foot and diffused daylight from 20 to 40 candle-feet.

ELECTRIC RAILWAYS.

Polarity of the Earth's Return.—In the Lond. "Elec.," April 6, Mr. Dubs states that in connecting the negative pole of a railway circuit to the earth the current will enter water pipes by small amounts all along the line, but will leave it at the nearest point to the station, where the current density may become large enough to produce considerable electrolytic corrosion; if the positive pole is connected to earth there will be no corrosion near the station, while the currents which leave the pipes, being divided over a very large surface, will not produce any appreciable action; the latter was confirmed by the results of a two years' trial with the Marseilles railway, where no difficulty whatever has been found in connection with electrolysis. With the negative pole to earth the protection at the point nearest the station may be obtained by a good, reliable and well insulated metallic connection with the generator and the water pipes.

Weight of Trains.—According to the Lond. "Elec.," April 6, a train of the Liverpool line weighs, when fully loaded, 38 1-4 tons and seats 114 passengers; those on the City and South London line weigh 37 1-3 tons and seat 96 passengers; in the former the weight per passenger is 752 pounds, while in the latter it is 871, due to the fact that in the latter locomotives are used.

Genoa Railway.—A translation is given in abstract in the Lond. "Elec. Eng.," April 6, of the description of the Genoa railway, which differs in a number of respects from the systems as used in this country.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Parallel Working of Long Lines.—The second day's discussion of Mr. Mordey's paper, abstracted in the Digest last week, is given more fully in the Lond. "Elec.," April 6. A written communication from Prof. Forbes giving a mathematical examination of parallel working of alternators having no self-induction is given in the Lond. "Elec." April 6.

Statistics for Great Britain.—In a recent lecture by Dr. Fleming he stated that there are now 700,000 incandescent lamps in use in London and 425,000 in the provinces; in London there are 13 companies, and in the United Kingdom 60 to 70 towns have a public electric supply. The total length of the underground mains now laid is about 700 miles.

Train Lighting.—The "Elek. Zeit.," March 29, states that the German railways are not ready yet to adopt the electric lighting of trains, partially on account of the greater cost and because they claim that there has not yet been sufficient experience with this system.

Coatbridge Station.—The London journals of April 6 describe this station, which is of interest in that gas engines are to be used entirely, in connection with the alternating system, the gas being made in producers connected with the station. It will give a good opportunity to test the practicability or possibility of running alternators in parallel when driven by gas engines.

Livet Refuse Destructor.—"Ind. and Iron," and the Lond. "Elec. Rev.," April 6, contain articles on this destructor.

WIRES, WIRING AND CONDUITS.

Steamship Wiring.—The discussion in the Lond. "Elec. Rev." is continued in the issue of April 6, in which, however, nothing new is given.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Best Resistance for Receiving Instruments on Leaky Lines.—In an illustrated paper by Prof. Ayrton and Mr. Whitehead, published in the Lond. "Elec. Rev." and Lond. "Elec. Eng." April 6, the subject is discussed mathematically for the case of a single leak, a uniformly distributed leak, and in general leaks following a certain law, the result in all the cases being that "whatever be the nature of a leak on a telegraph line—whether the leak be a single one or be distributed along the line according to any law of distribution—the same rule holds true for the best resistance to give the receiving instrument, viz.: the receiving instrument at either end should have a resistance equal to the apparent resistance of the line when tested from that end and put direct to earth at the other end." It is assumed that the resistance of a coil of wire occupying a given form and volume is proportional to the square of the number of convolutions.

A Sensitive Microphone.—In an article by Mr. Soulby in the Lond. "Elec. Rev.," April 6, he describes a simple form of a very sensitive adjustable microphone; it consists of two blocks of carbon secured to a vertical sounding board and a round cylinder of carbon connecting one with the other and suspended by light threads, the inclination of the sounding board being adjusted so that the cylinder is just in contact; numerous experiments are described showing its extreme sensitiveness; among others it was stated that a rushing sound was heard when the hand was placed on the sounding box, which was said to be that of the rapid circulation of the blood through the veins.

Duplex Telegraphy.—An application of the Mance battery resistance test to duplex telegraphy is described and illustrated in the Lond. "Elec. Rev.," April 6.

Telephone Charges in Europe.—In an editorial in the Lond. "Elec.," April 6, some corrected and supplementary figures are given.

Railroad Signals.—An article by Mr. Prasch describing, with the aid of a number of illustrations, a new controlling signal system for railroad signals is published in the "Elek. Zeit." March 29.

ELECTRO-CHEMISTRY.

Purification of Sewage.—A brief abstract of Dr. Kelly's report of the Worthing tests is given in the Lond. "Elec." April 6. Chemically, the electrolyzed sea water contained only one-sixtieth of the equivalent of chlorine that exists in a saturated solution of ordinary bleaching powder; in two days' standing 5 per cent. of the strength of the solution disappeared; it does not contain free chlorine, nor does it give an acid reaction; when compared with a strong solution of bleaching powder, it will not act as powerfully—neither in reducing the offensive odor, nor in the breaking up of the solidity of the sewage, nor in corroding the vessels; copper, brass, bare and galvanized iron were appreciably corroded, but there was no effect on cements. The bacteriological experiments show that the Hermite process, as there carried out, is incapable of sterilizing sewage; cultures in gelatine of the ordinary sea water, the Hermite fluid and the freshly treated sewage gave the following results: Bacilli in great numbers were found in the ordinary sea water, but the Hermite fluid proved to be perfectly sterile, showing that direct electrolysis caused sterilization; the freshly treated sewage produces enormous colonies of microbes. It concludes that the Hermite process is not a success.

Mr. Cooper for Mr. Hermite claims that these conclusions are utterly opposed to results found by many of the most eminent experts, and that he believes that there must be some mistake in taking the samples. The report is published in full in the Lond. "Elec. Eng." April 6, and contains considerable data.

Electrolytes and Non-Electrolytes.—In a brief mention in the Lond. "Elec. Rev.," April 6, of some experiments of Mr. Jones it is stated that he was led to the unexpected conclusion that non-electrolytes exhibit abnormal depressions of a character similar to those of electrolytes.

Nickel Plating.—The "Elek. Zeit.," March 29, reprints about a dozen different recipes for good nickel baths, collected from different sources and intended for various purposes.

MISCELLANEOUS.

Electro-Physiology.—"La Nature," March 10, contains a well illustrated article by Mr. Guillaume, a translation of which, together with all the illustrations, is given in the Lond. "Elec. Rev.," March 23. It describes the recent experiments of Dr. d'Arsonval, which, it is claimed, form a counterpart of Tesla's experiments; the apparatus is simpler and produces less powerful effects, but it is within the reach of all laboratories; it is claimed that the physiological actions of currents of all frequencies were solved in France long before Mr. Tesla's publications in America. Such currents are produced by connecting the secondary of a Ruhmkorff coil to the inner coatings of two Leyden jars, the discharge between the two balls of which is oscillatory; the ends of a short coil of 10 spirals of thick wire are connected to the outer coatings of the jars, and in these currents of high frequency are generated; if a wire short circuits this coil long sparks are produced at the junction; if the short circuiting takes place through the body there is no shock, not even the slightest tingle; to show that this current passes through the body, the body may be connected through an incandescent lamp, which lights up brilliantly; the current is said to pass over the surface of the body, and while there is some truth in this, it is not the only cause of its harmlessness; Dr. d'Arsonval has shown that the neuro-muscular phenomena increase with the frequency up to 3,000, remain stationary to 5,000, and then decrease and cease altogether; a frog's leg is insensible to Hertz's alternator; if the current is closed through the hands, the skin becomes insensible, which lasts from a few minutes to half an hour; if the body is insulated and only one pole held, heat is produced, accompanied by copious perspiration, and considerable vascularization of the cutaneous surface; if a little wound is made in the foot of an animal, so that the blood escapes by drops, the hemorrhage becomes very abundant under this current, showing that there is a powerful force at work to dilate the vessels; the current passes through the body, but the nerves have become insensible. He has shown that death from alternating currents is due, in the first place, to asphyxia, and that artificial respiration may be resorted to, and in the second place the excessive heat produced by the muscles brings about the coagulation of the blood; by an illustration he shows that a series of lamps may be lighted with a current passing through the body; a lamp connected with a ring of copper placed on the head may be lighted by a coil placed around the head somewhat

lower, an experiment which is said to show that the head is traversed by similar currents; in another illustration the terminals of the lamp are held in the hand, which, with the arms, forms a circle around the solenoid; in another experiment the lamp is similarly held by a person placed inside of a large solenoid. To measure the relative intensities of these currents he passes them through a small solenoid around a mercury thermometer, the reading of which is said to be proportional to the current if the frequency does not vary too much.

Electricity in Pipe Laying.—The Lond. "Elec. Rev.," April 6, describes briefly the application of a sort of locomotive of three-horse power, which was used in Paris in the laying of water pipes of very large diameter and weight, in underground culverts; the pipes were lowered through the manholes on to the locomotive, on which they were then carried through the tunnel to the proper places; the locomotive was run with 40 accumulators; a steam locomotive would not have been applicable without special means of ventilation, and then only with great inconvenience.

Formation of Amalgams.—According to a note in the Lond. "Elec. Rev.," April 6, the manufacture of amalgams may be greatly facilitated by the influence of high tension electricity, such as that from Leyden jars; it was found that the per cent. of amalgam formed was more than three times as great when such currents were used as when no current was used.

Electrical Exhibition.—According to the Lond. "Elec.," April 6, it is proposed to hold an international electrical exhibition in Paris in 1895, to be opened in July; it is to be held in two large exhibition buildings in different parts of the city, placing the generators in one and the motors in the other, and connecting the two by electric railways and electric launches.

Exhibition Report.—The "Elek. Zeit.," March 29, announces that the final report of the expert tests made at the Frankfort International Exhibition of 1891 has at last been published. No data are given in that notice.

Suggestions for Transit Systems.

BY S. D. MOTT.

There is a persistent municipal opposition to poles, wires or electric conductors of any kind on or over the streets of most American cities. This, as most of us know, was brought about originally by reason of the fatal accidents due to the existence of old, dilapidated wires, in many instances not in use, and which should have been removed, forming circuits with the heavy currents necessary to the

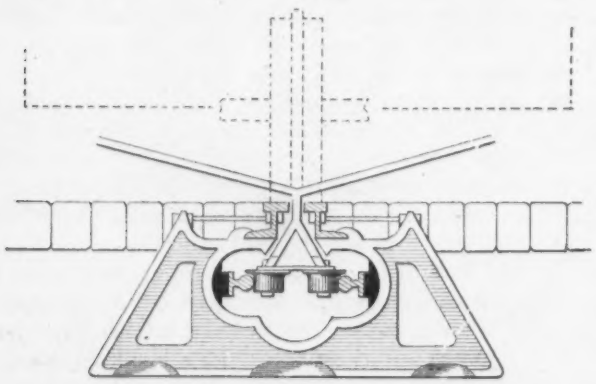


FIG. 1.

commercial introduction of electric lighting and power transmission. Be the causes what they may, and there are others contributing to this crystallized common sense, the "deadly trolley" and the assumed equally dangerous charged rail when street traction schemes are under consideration, the scoop net premiums offered by interested corporations, etc., indicate a public demand for a departure from the present established system of city surface transit and a more satisfying solution of a pretty tough problem

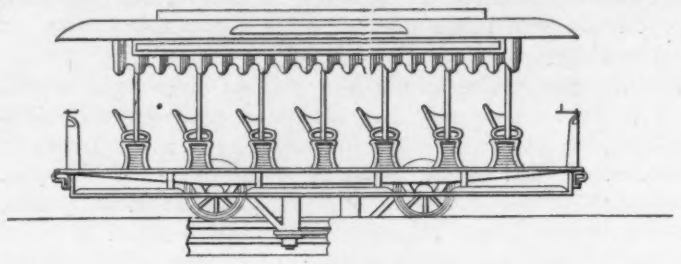


FIG. 2.

at best, when the exacting conditions of service are considered; something, anything that will make electric traction what it ought to be, and I believe will be, when its period of evolution has passed, the most perfect system of land propulsion ever devised by the mind of man. The accompanying sketches suggest a system of street surface lines

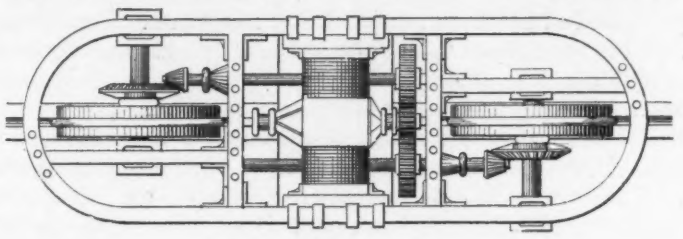
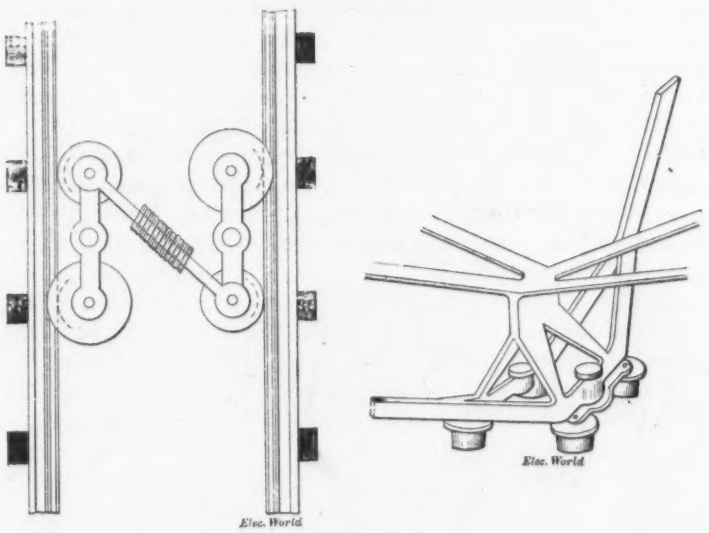


FIG. 3.

which has marked characteristics—I may add, too marked, and the proposition too much of an innovation to meet with business encouragement—but I believe that a street system built substantially on these lines is practicable.

The ideal characteristics mentioned are an entire absence on the street of rails (as such), poles, lines, or electric cur-



FIGS. 4 AND 5.

rent; phenomenal conditions; can they be realized? They can certainly best be realized when using electricity as a motive agent.

I venture the prediction that the engineering world will have their ideas modified before a great while respecting the principles governing, as also advantages accruing from, what may be described as bicycle propulsion.

We have bicycle surface lines on a restricted scale at present, both steam and electric, for long distance service, why not a bicycle street system? The drawings attempt to show such a system, and although they are some nine years of age, I take it they are sufficiently clear to need no careful detail description.

The two or more supporting and guiding wheels are made with a centre flange and double tread, and are fashioned wide and strong. The lateral support of car, such as is needed when at a standstill, is furnished by the horizontal sub-surface rails (Fig. 1) within the conduit, which rails are also the working conductors.

The trolley wheels are mounted with the idle wheels and coiled spring in such a way as to give a certain amount of flexible lateral play and at the same time always keep their contact. The harder the trolley is forced to the right from any cause the more firmly the collector on left is pressed against the conductor and vice versa. This will be readily understood by inspection of Fig. 4. Fig. 1 is a cross-section of roadbed showing the arrangement of conduit, shape of

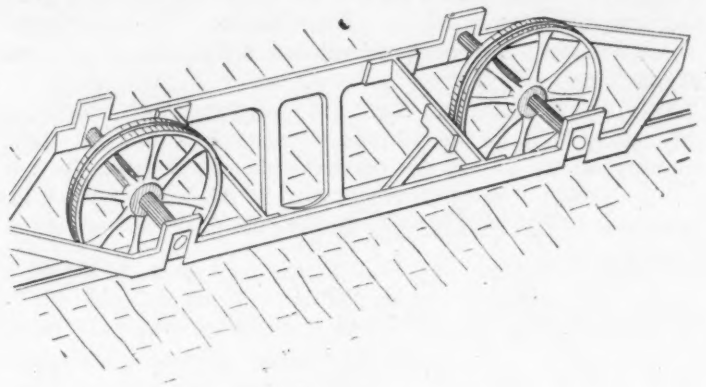


FIG. 6.

rails, and position of sub-surface devices, etc. Fig. 2 is a side elevation of car showing its general appearance equipped for service with part longitudinal section view of the conduit.

Fig. 3 is a plan view, showing a car equipped with a double driving motor and its reducing gear. Fig. 4 is a plan view of twin trolley or collectors.

Fig. 5 is a perspective view of a form of plow and collectors, and Fig. 6 is an isometric perspective of rolling stock without the car equipment.

This system should operate with far less friction than the ordinary road, besides the advantage gained from absence of street obstruction and disfigurement, and it should take curves more naturally and with less friction by proper alignment of roadbeds than the ordinary broad gauge vehicle.

Tests of Car Heaters.

The Atlantic Avenue Railway Company during the month of February made a number of tests on electric car heaters in cars of different construction, and we are enabled to give some of the data in the table below:

—Cars.—			—Temperature.— Fahrenheit.		Wind.	—Electrical Data.—		
Doors.	Side windows.	Contents, cu. ft.	Outside.	Inside.	Velocity, miles.	Volts.	Amperes.	Watts.
2	12	850.5	28°	51°—59°	25	433	5.3	2,295
2	12	850.5	7°	34°—44°	28	436	5.3	2,325
2	12	808.5	28°	47°—52°	25	436	5.0	2,180
2	12	913.5	35°	40°—64.5°	3	431	6.3	2,745
4	16	1,012.37	7°	41°—50°	28	422	7.2	3,038
4	16	1,012.37	28°	48°—60°	25	427	7.24	3,160

Four electric heaters were used in the first three cars on the list and six in the others, connected in series in each case. The temperature is that shown by a thermometer in the centre of the car. The average temperature is somewhat higher than the mean of the maximum and minimum temperatures given, particularly in the case of the fourth car, in which the temperatures did not fall below 51 degrees after the first half hour. The time of the trips during which the above data were taken varied from one hour to two hours and twenty-five minutes. The heaters used were those of the Central Electric Heating Company.

The Calculation of Alternating Current Motors.—VIII.

BY E. ARNOLD.

THE coefficients b_1 and b_2 have regard to the leakage. All the lines of force which do not cut the windings of the armature or inductor, A, do not assist in the creation of a torque. Leakage takes place at the outer circumference of the field, F, as well as at the side surfaces; furthermore, part of the lines pass through the iron pieces, which enclose the wires and do not keep the induction in the armature. In Fig. 17 this leakage is indicated by dotted lines. Part of the lines of force pass through the air space δ, without cutting the windings of the armature. The leakage is larger the greater the induction B, the greater the air space δ, and the greater the

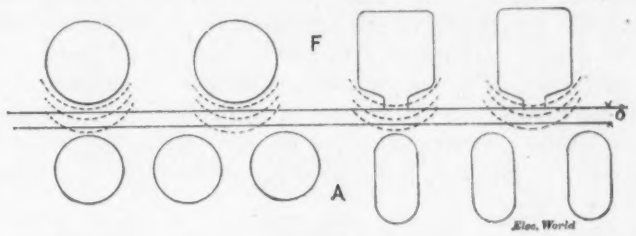


FIG. 17.

saturation of the iron core. We put $b_1 b_2 = b$, and obtain from equations (87), (85) and (82) the following *important equations for the calculation of a motor*:

$$\overline{E_2} = b \frac{N_2}{N_1} \overline{E_1}\, v. \qquad (88)$$

$$I_2 = \frac{b}{R_2} \frac{N_2}{N_1} \overline{E_1}\, v. \qquad (89)$$

$$W = b^2 \frac{s_2}{R_2} \frac{N_2^2}{N_1^2} \overline{E_1^2}\, v\,(1 - v). \qquad (90)$$

$$R_2 = b^2 \frac{s_2}{W} \frac{N_2^2}{N_1^2} \overline{E_1^2}\, v\,(1 - v). \qquad (91)$$

$$D = b^2 K \frac{s_2}{R_2} \frac{N_2^2}{N_1^2} \overline{E_1^2} \frac{v}{p_1}. \qquad (92)$$

$$n_2 = \frac{60\, n_1}{K}\,(1 - v). \qquad (93)$$

These formulae are simple and intelligible. For $v = 1$, the relation between the secondary and the primary potential is, according to equation (88), the same as with a transformer, equal to the transforming ratio multiplied by the coefficient of the fall of potential, b. With a definite slip, v, assumed beforehand, the current strength in the armature and the output in watts of the motor can be calculated from equations (89) and (90). But as the output in watts is usually given also, the resistance R_2 belonging to one phase of the armature is found from equation (91). As follows from

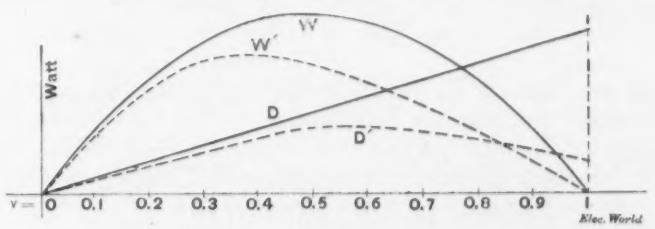


FIG. 18.

the equations, the watt output becomes a maximum for $v = 0.5$ and the torque for $v = 1$, supposing that b does not change. If we set down the values of the slip as abscissae and the watts as ordinates, under the supposition that E_1 is constant, the values of the torque and the output of the motor will change with the ordinates of the curves D and W

Fig. 18. For greater values of v, or the difference $(p_1 - p_2)$, however, the term $(p_1 - p_2)^2 \left(L_2 \frac{s_2}{2}\right)^2$ in equation (81) is not to be neglected, and the value of b diminishes with increasing slip. The curves W and D will, therefore, take a course which may about coincide with the dotted lines. In practical cases, moreover, E_1' does not remain constant, and the curves W and D will, therefore, fall away toward the axis of abscissae even more rapidly.

As seen from equation (90), the slip for a given output of the motor can be made to vary by changing the resistance R_2 or the primary potential E_1. It is, therefore, possible, by altering these values, to regulate the speed of the motor. This regulation can reach from the position where $p_2 = p_1$ only as far as the torque increases. Had we a perfect rotary field, and were b constant, a speed regulation nearly from $p_2 = p_1$ to $p_2 = 0$ would be possible. Through the influence of the variation of b and the presence of periodic fields, the maximum of the torque does not lie at the place where $v = 1$, but appears shifted toward the position where the value of $v = 0$. The more the leakage increases with the slip, the greater the self-induction of the armature; the more strongly the periodic fields are developed and the more the potential E_1' falls off, the nearer the maximum of the torque will lie to $v = 0$.

In dependence upon the current strength, there result the following equations, with the same approximation:

$$D = \frac{m^2 s_2 p_1 M^2 I_1^2}{4 R_2} v. \qquad (92\text{ a})$$

$$W = \frac{m^2 s_2 p_1^2 M^2 I_1^2}{4 R_2} v (1 - v). \qquad (90\text{ a})$$

The *watt loss* in the armature is

$$W_s = s_2 R_2 I_2^2;$$

the *watt loss* in the primary windings,

$$W_p = m R_1^2 I_1^2.$$

If we designate the losses due to hysteresis, Foucault currents, friction of bearings and air resistance by W_h, the *efficiency* of the motor becomes

$$\eta = \frac{W}{W + W_s + W_p + W_f}. \qquad (94)$$

THE CALCULATION OF THE EXCITING CURRENT AND OF THE LOAD CURRENT.

The relation of the exciting current to the current at full load is the factor which characterizes the value of a non-synchronous motor. Letting I_ω epresen t the useful current, or that which would, without shifting of phase, deliver the watts consumed by the motor, and I_0 the exciting current, we have

$$I_\omega = \frac{W}{\eta m E_1}. \qquad (95)$$

The load current

$$I_1 = \sqrt{I_0^2 + I_\omega^2}. \qquad (96)$$

$$\cos \Phi_1 = \frac{I_\omega}{\sqrt{I_0^2 + I_\omega^2}}. \qquad (97)$$

If the primary E. M. F. be kept constant, the output of the motor will regulate itself, not, as in direct current motors, by the change in I_1 alone, but as I_0 remains constant, by a simultaneous alteration of the phase-shifting Φ_1, as Fig. 19 shows for two strengths of current I_1 and I_1'.

The output of the motor is fixed by I_ω, but in the consideration of the primary copper, the conductors and the generator I_1 is determinative. If, therefore, in an alternating current motor plant the conducting network and generators or transformers are not to be overloaded with useless currents, the motors must be constructed for small exciting currents, for otherwise the usefulness of the whole plant would become questionable. The shifting of phase must be taken into account in designing the conducting network and the generator.

In order to keep the exciting currents small, a narrow air space, δ, and low magnetic saturations are to be chosen. As the number of ampere turns per one centimetre of the circumference of the field is limited on account of increasing

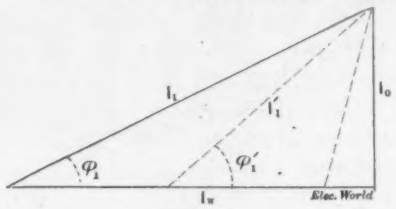


FIG. 19.

leakage, low saturations can be reached only by enlarging the dimensions of the iron of the motor. The attainment of low exciting currents is therefore substantially a question of cost.

With motionless armature and open armature windings, the motor will take up only the exciting current. But when running with no load, the current differs little from the exciting current, I as ω is very small in this case. We find, therefore, from equation (73) that the exciting current, when $p_2 = p_1$, is

$$I_0 = \frac{2 E_1}{m p_1 L_1}. \qquad (98)$$

For rotary current motors $m = 3$, and

$$I_0 = \frac{E_1}{3 \pi n_1 L_1}. \qquad (99)$$

According to Fig. 16, letting

U be the circumference of the armature in centimetres.

$F_1 = 0.85\ h_1 l$, the effective cross-section of the iron of the field.

$F_2 = 0.85\ h_2 l$, the effective cross-section of the iron of the armature in squared centimetres.

δ = the air space in centimetres.

$F_0 = \frac{U l}{4 K}$, the cross-section of the air space per magnetic circuit.

l_1 approximately $= \frac{U}{2 K}$, the course of the lines of force in the field iron.

l_2 approximately $= \frac{U}{2 K}$, the course of the lines of force in the armature iron.

K, the number of pairs of poles.

Then will

$$L_1 = \frac{2 \pi N_1^2}{10^9 K \left(\frac{2 \delta}{F_0} + \frac{l_1}{\mu_1 F_1} + \frac{l_2}{\mu_2 F_2}\right)}. \qquad (100)$$

The value of μ_1 and μ_2 can be calculated from any magnetization curve, as

$$\mu = \frac{\text{induction per square centimetre}}{\text{magnetizing force}} = \frac{\mathfrak{B}}{\mathfrak{H}}.$$

According to my tests, equation (99) gives results agreeing almost exactly with the experiments.

The current without load, or exciting current, can be determined in yet another way, though with less certainty, by basing the calculation on the intensity of the rotary field, according to equation (85). Representing the magnetizing forces for the field and armature iron, respectively, by H_1 and H_2, which are to be taken from a magnetization curve, there will result, since the number of ampere turns $= \frac{1}{2} m I_0 N_1$,

$$I_0 = \frac{1}{6} \frac{K (2 \delta \mathfrak{B} + \mathfrak{H}_1 l_1 + \mathfrak{H}_2 l_2)}{m N_1}. \qquad (101)$$

As the number of poles, $2 K$, grows with the number of cycles, n_1, the speed of the motor remaining constant, it can

be seen that the current, when running without load, must increase with the number of poles, and therefore with the number of cycles. This influence of the number of poles can be most effectually met by having smaller strengths of field, or relatively, by increasing N_1.

If I_0 is calculated and I_ω determined from equation (95), the load current, I_1, will follow from equation (96).

The load current thus calculated will be somewhat smaller than the actual one. This is in consequence of the leakage increasing with the current strength, whereby the primary shifting of phase is made larger (vide equation (104)). Letting I_1' represent the actual load current, we shall have with close approximation

$$I_1' = \frac{\sqrt{I_0^2 + I^2\omega}}{b^2}. \qquad (102)$$

If I_0 and I_1 be observed and I_ω calculated, the corresponding value of b can be derived from the above equation.

If the shifting of phase Φ_1 be altered by apparatus which does not belong to the motor, equation (102) does not hold good. It shows, however, the influence of the leakage.

(To be continued.)

Improved Tandem Compound Engine.

The M. A. Green automatic cut-off engines, manufactured by the Altoona (Pa.) Manufacturing Company, have established a deservedly high reputation, and in this issue we illustrate the tandem compound type.

One of the important features of this type is that both pistons can be removed by merely taking off the low pressure cylinder head and the nuts that hold the intermediate or packing head in position. It is not necessary to remove the low pressure piston from the rod or disturb any part of the valve gear or displace the cylinders.

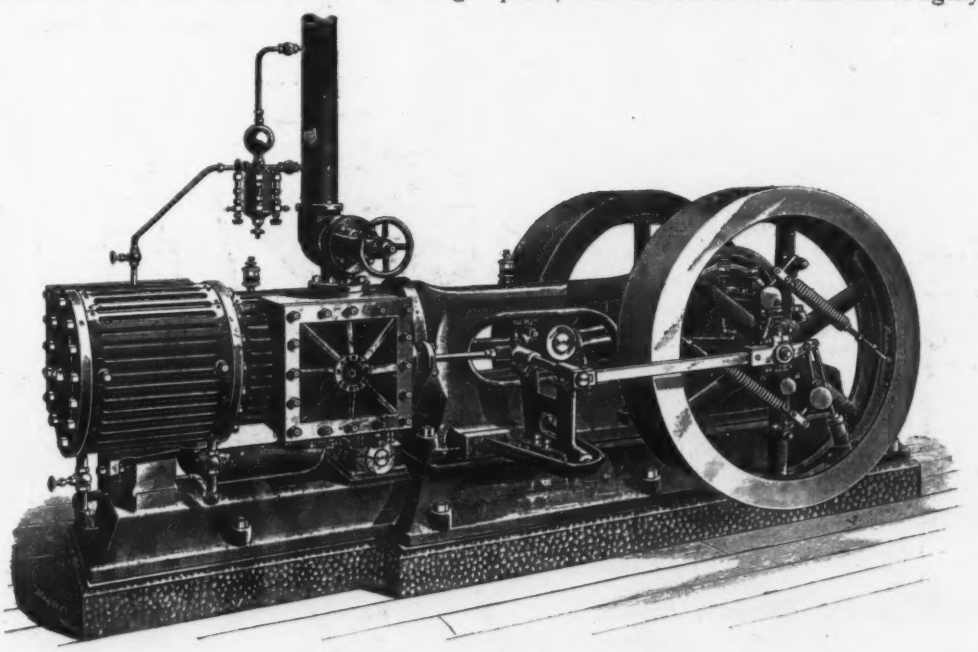
Another valuable feature is that there are no stuffing boxes between the two cylinders. The packing that is in the middle head is a newly designed double metallic packing, which will last from four to five years and require no attention whatever. The stuffing box on the high pressure cylinder is also packed with a new improved metallic packing, which will last about the same length of time.

The bearings are bored by a special boring mill, which insures the utmost accuracy in the alignments. Special babbitt shells are used for the main bearings. The centre core of the mould for casting the shells is increased a fraction in diameter over that of the shaft, and the outer shell of the mould is also a fraction larger. By this method allowance is made for the natural shrinkage of the babbitt shells, so that they may absolutely fit the main bearings on the outer and inner diameters, requiring no spotting or fitting. The smooth surface on the babbitt is thus retained as it comes from the moulds, experiments having shown that the surface or skin produced on the babbitt by casting them in smooth moulds wears much longer and smoother than if that portion of the babbitt were scraped off.

The valve is remarkable for its simplicity and ease of operation, being as perfectly balanced as a piston valve and at the same time is at liberty to leave its seat, even more easily than an ordinary "D" slide valve; for the moment the pressure in either cylinder increases a small percentage over that of the steam pressure, the valve will rise, thus relieving the pressure and resuming its seat as soon as the pressure again becomes normal.

The governor of this engine will, under wide variations of load, regulate within 1 per cent., and much closer if desired. The parts of the governor have anti-friction bearings, which do away with the annoyance of oil. The main bearings also have oil receivers, which return any drippings of oil back into a reservoir in the bed. The discs are completely covered with a hood, so that the engine is absolutely free from the annoyance of throwing oil. It will be noticed that only the high pressure cylinder valve is operated by a governor, while the low pressure valve is operated by an adjustable eccentric, which has a constant cut-off of from one-third to three-quarters. Experiments have shown greater economy and smoother running with this arrangement than if the low pressure valve were operated by an automatic governor.

The crank shafts are made from a fine quality of forged steel, and the cast iron discs have heavy counterbalances, so as to thoroughly balance the weight of the reciprocating parts, and are bored true and thoroughly fitted to the arms of the crank shafts by an improved method, which produces a practical fit, bolts or babbitt or similar expedients not being used for this purpose. The shaft is extra large in diameter, and has long bearings; the crank pin is the full diameter of the shaft, and all the bearings are ground true.



TANDEM COMPOUND ENGINE.

The connecting rod does away with bolts and keys on the centre crank engine, enabling a bevel block to be used to make the adjustment with one screw. This block being the full breadth of the rod, not only forms a firm backing, but admits of nice adjustments. The wheels have extra heavy rims with split hubs. This removes all danger of breakage of wheels by unequal shrinkage, and further enables the shaft

to be clamped more thoroughly, and the heavy rims insure smooth rotary motion.

Through one of the annoying accidents that sometimes occur in a printing office, some copies of our last issue were run off the press with the wrong illustration accompanying the description of this engine in that issue.

Mechanical Stoker.

While in recent years the land steam engine has been vastly improved, the consumption of water per horse power having been reduced from over 30 to as low as 15 pounds in some of the most economical types, proper attention has not been given to the boiler room. With even the most economical type of engine, no better results may be attained in fuel consumption than with an ordinary cheap engine if in the latter case proper attention is given to the method of feeding fuel into the furnace. The ideal method of firing a boiler is by mechanical means, because the fuel can only thus be supplied in exact accordance with the requirements for economy, and provisions made in conformity with scientific principles for its proper combustion. As a consequence, we are always pleased to refer to improvements in stoking apparatus, and we illustrate herewith the Jones underfeed mechanical stoker, manufactured by the Jogada Furnace Company, Portland, Ore., which possesses several features of interest.

Fig. 1 shows the working parts of the stoker, but with the hopper not in position over the opening for it that is shown. Fig. 2 shows the ram which forces the coal into the furnace. The part of the stoker shown in Fig. 1 only occupies about a third of the width of the furnace, and grate bars are laid on each side, one of the bearing bars upon which the ends rest being shown on the side. The coal is forced by the ram along the central channelway, and the top of the fuel gradually falls over on either side to the grate bars. A blower furnishes the air necessary for combustion at a pressure of about four inches of water, entering the central mass of coal through openings or tuyeres.

To explain the operation of the stoker, we will commence with no steam on the boiler. The retort is first filled with coal, level with the top of the tuyere pipes, and fire then started on the side grates as usual until steam is raised. The ash pit doors that admit air to the side grates are then closed, and the coal is placed in the hopper outside of the boiler front. The steam ram is then withdrawn by shifting the lever, when the desired quantity of coal falls from the hopper in front of the ram, and upon the return stroke is forced into the retort. Air under pressure is next admitted into the tuyere pipes, which issues through slots over the top of the fuel in the retort, but under and through the burning fuel. The result is that the heat from the burning fuel over the retort slowly liberates the gas from the green fuel, and being thoroughly mixed with the incoming air before it passes through the burning fuel above, results in a bright, clear fire, free from smoke, and the complete consumption of the fuel. The retort being practically air-tight from below, and the fuel being in a compact mass in the retort, the air will find its way in the direction of the least resistance, which is upward, and consequently combustion takes place only above the air slots, so that the castings of the retort are always cool and not subject to the action of the fire. The incoming fresh fuel from the retort forces the resulting ash and clinker over the top of the tuyere pipes, on to the side grates, from whence they may be removed at any time without in the least interfering with the fire in the centre of the furnace. A heavy body of coke is at all times carried in the furnace, and the amount of coal consumed regulated entirely by the quantity of air forced in the furnace. The furnace is never charged with more than 100 pounds of coal at a time, it being better to put in small charges and at as regular intervals as possible, thereby giving the coal ample time to coke before being forced above the air slots and into the fire.

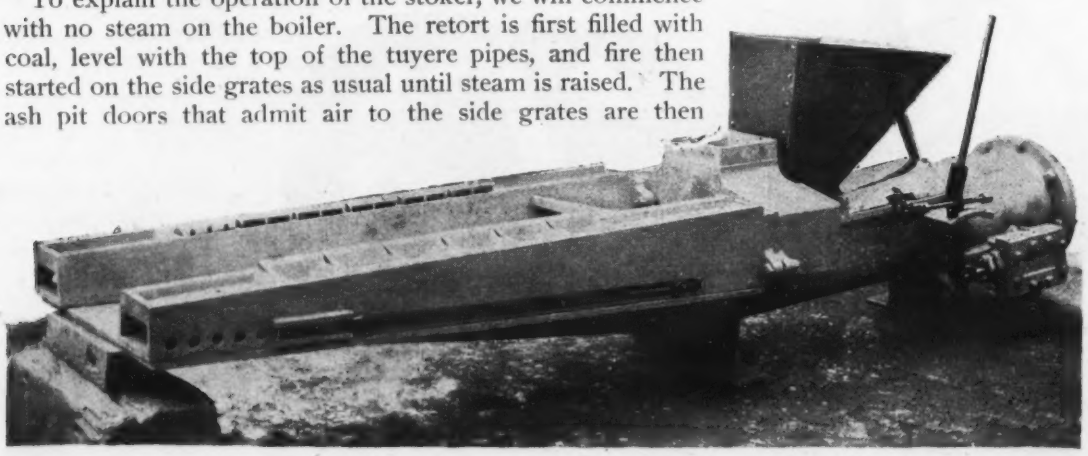


FIG. 1.—MECHANICAL STOKER.

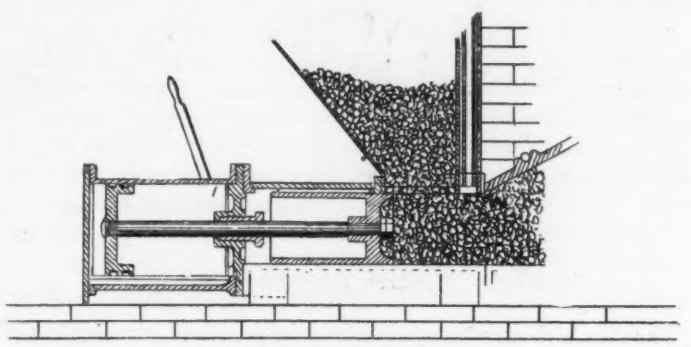
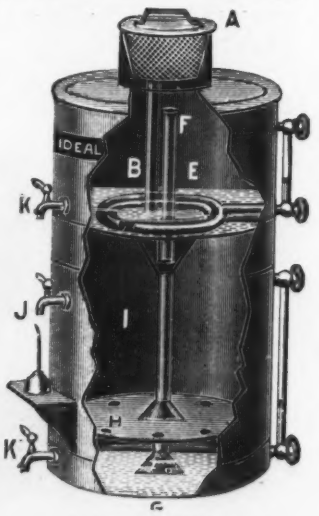


FIG. 2.—MECHANICAL STOKER.

Purity Oil Filter.

The oil filter we illustrate, manufactured by the Purity Oil Filter Manufacturing Company, 90 Water street, Pittsburgh, Pa., and known as the Imperial Ideal Steam Old Refiner, is a well designed oil purifier based upon correct principles.



OIL FILTER.

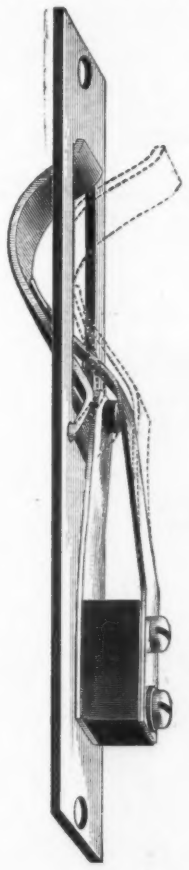
The refining chamber sets on top of the storage or purified oil chamber, giving it the appearance, when in operation, of an oil tank. As each day dirty or drip oil is poured into the refining chamber, the oil previously there is raised, as the dirty oil is the more dense. When the chamber is filled, the lightest and purest of the oil is on top. During the filling of this chamber, the oil is subjected to a little steam heat, which so reduces its viscosity that all matter heavier than the oil sinks to the bottom. As the drip oil is

poured in, the purified oil overflows at pipe *F* and passes to the bottom of the purified oil chamber, rising through water again. When the oil reaches the faucet, *J*, it is as cool as the air around the shell and ready for use again.

In ordinary steam purifiers or filters, the oil is liable to be found boiling when wanted for use, with all the air cells burst, thus dstroying its lubricating qualities. Even should the oil in this filter boil and burst the air cells, it becomes reoxidized and cooled as it passes from one chamber to the others through the air, as it is four or five days from this time until it reaches the faucet for use. The pan, *H*, in the purified oil chamber is for the purpose of catching all precipitation that may occur during the time the oil is cooling. When the refining chamber is lifted off, the pan can be drawn out slowly without emptying the cooling chamber, bringing all dirt from this part, thus enabling it to be kept clean. The oil is passed through nothing but water, and consequently there is no expense for filtering material.

A New Window Spring.

The window spring illustrated below is the latest production of Messrs. Geary & Mossep, and is now being manufactured by them in the factory of the Arnold Electric Company, at Chester, of which Craig R. Arnold is the selling agent, with offices at Chester and 308 Walnut street, Philadelphia.



WINDOW SPRING.

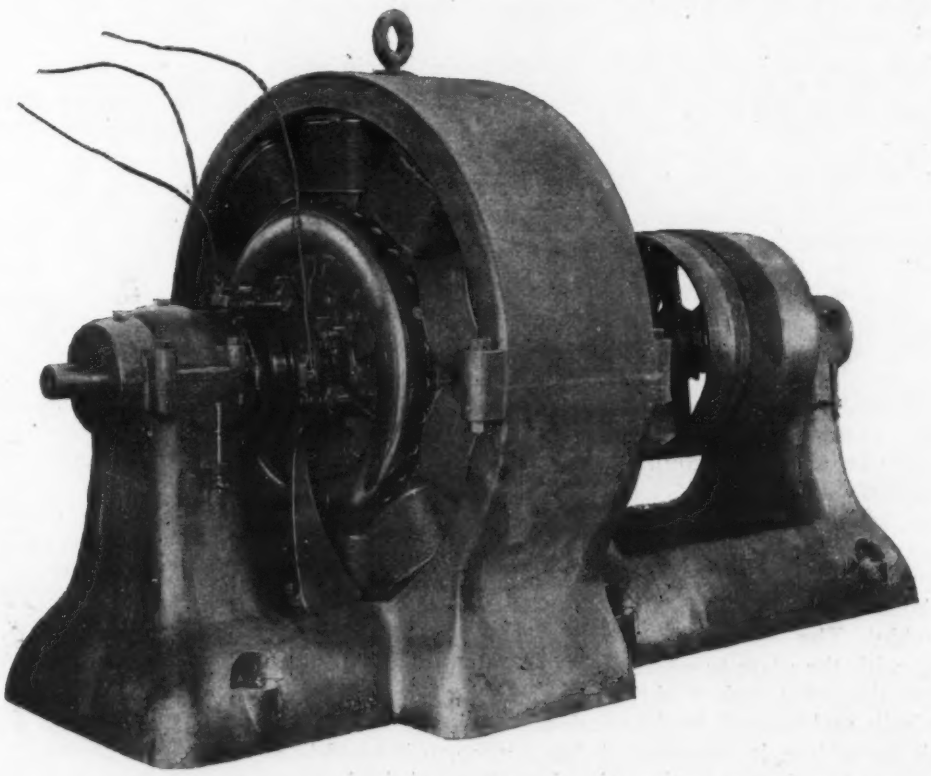
The great trouble heretofore experienced in the manufacture of such a simple device as an electric window spring has been their unreliability on account of rust and corrosion of the contact parts. They have been of such irregular shapes that more or less difficulty is experienced in fitting them into the window frames, and heretofore considerable movement of the window has been required to make contact in the spring on account of the great movement necessitated by the design of the tongue or circuit closing part.

In this spring brass screws are used, and the springs are made out of a high grade of German silver, thereby overcoming the features of rust and corrosion. It will be seen from the cut that the tongue is made to hinge on the frame by two little extensions or lugs engaging in two holes in the frame. This construction admits of the tongue being removed and a new one substituted without the use of any tools or the removal of any pins or screws.

New Three-Phased Apparatus.

The apparatus employed by the General Electric Company in its three-phased power transmission work has all been designed with a view to obtain high commercial efficiency and close regulation. The illustration shows a 300 kw. three-phased generator. The armature and field coils are all highly insulated, so that the danger of accidents is reduced to a minimum, and fairly high voltages may be used with the certainty of obtaining a thoroughly reliable machine. The bearings are self-aligning and self-oiling, and the armature being carefully balanced upon rigid supports, the machines run with scarcely a tremor. The magnetic circuit and the windings are so proportioned that the machines run exceptionally cool and require little or no attention to the rheostat, even under considerable changes of load.

In the large direct driven machines, and in all cases in which light weight is essential, the magnetic circuit, aside from the armature, is of cast steel. The standard periodicity employed is 60 cycles per second, or 7,200 alternations per minute. This is sufficiently high to permit the use of incandescent and arc lamps and the employment of all standard transformers. It is also low enough to allow the use of induction motors under the most advantageous conditions, and to avoid trouble from self-induction and capacity effects on the line except at very great distances.



THREE-PHASED GENERATOR.

Certain of these machines are arranged to run at 33 cycles, which periodicity is that adopted for very long work, in order to reduce the induction and capacity effect on the line, and in plants where the use of rotary three-phase continuous current converters is of prime importance. All of these three-phase generators can be arranged for direct driving from Pelton wheels, and the larger units lend themselves with facility to direct coupling to turbines. They have an

efficiency of at least 90 per cent., rising to 95 per cent. in the largest sizes.

With slight changes they can be used as self-starting synchronous motors. They come up to speed under light loads without the intervention of clutches or starting motors. They are fully as efficient as the generators, run in absolute synchronism with them, even under heavy overload. Synchronous motors are of especial value in power transmission, as by strengthening their fields it is possible to compensate for loss of voltage due to induction in the line. A three-phased motor of 15 h. p., in use at Concord, N. H., was illustrated in The Electrical World of March 17, 1894.

These motors are substantially equal to good shunt wound motors, but have no moving contacts, the only connection with outside circuit being through the three binding posts on the top of the motor. The magnetic part of the field and armature is constructed of annealed laminated iron. The current from the outside circuit passes through windings imbedded in the stationary field punching. The winding of the armature has no connection with the electric circuit, but is short circuited on itself through a small number of heavy copper bars united at the ends by connectors. It is furnished with a starting resistance placed within the armature spider. At starting, a sliding collar along the shaft is kept out of contact with the switch, serving to short circuit the resistance. When the motor is nearly at speed the contact ring is slid along the shaft, engages the switch points and short circuits the armature. This renders possible a large starting effort with a current limited by the resistance, which is so adjusted as to give a starting torque equal to the running torque at full load with somewhat less than the full load running current.

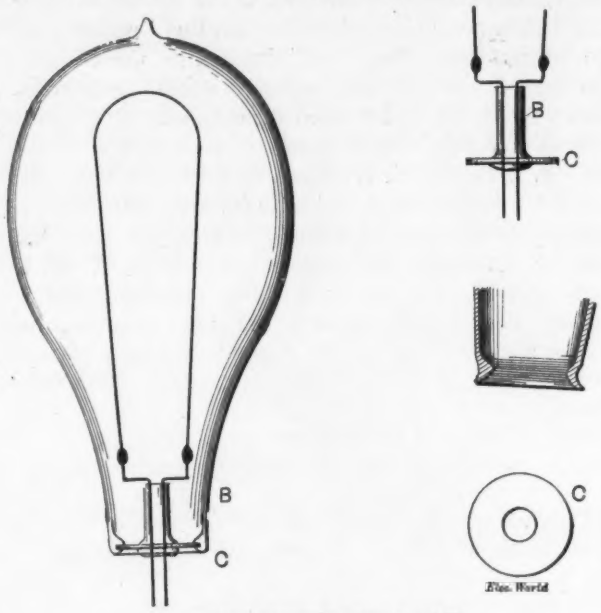
The massive character of the armature winding, in which the E. M. F. is only from 10 to 25 volts, renders burn-outs almost impossible, and the absence of commutators and collecting rings obviates the danger of sparking. It is claimed that these induction motors are electrically equal to direct current machines of the same capacity. They are recommended for all units below 100 h. p., above which synchronous motors would be preferable.

New Incandescent Lamp.

The peculiarity of the incandescent lamp we illustrate, recently patented by George C. Swan, Brockton, Mass., lies in the use of a flat platinum or other metallic disc, which is sealed in the neck of an ordinary lamp bulb and carries the stem, which is fused to the edge of a hole in the disc. The illustration shows the disc separate, and sealed, with the stem, into the neck of the bulb. It is claimed that this form of lamp is simple and easy of construction and exceedingly durable. The disc being flat, while it will expand and contract with the glass to which it is fused, lying as it does between the outer surface of the stem and the inner surface of the bulb, and being joined to each at practically right angles with its surface, it cannot work loose nor can it so yield as to cause any change in the cubical contents of the bulb, so that when the lamp is once made, its contents always remain exactly the same and its work therefore is constant.

It is apparent that in this lamp when the filament is broken the bulb can be broken so as to leave the disc carrying its leading-in wires still fused together. A new filament can be easily affixed to the leading-in wires and the stem and disc used a second time as a completed article for introduction into a new bulb. Moreover, it will be seen that the stem is not a mere globule of glass but is a support of suitable length carrying the leading-in wires and supporting them for a greater part of their length, thereby bringing the lower ends of the filament well within the bulb, so that but a small portion of the light from the filament is lost, and at the same time forming a more perfect seal than when a short stem or button is used.

One of these lamps has been steadily burning for 3,000 hours without showing the slightest discoloration, and the

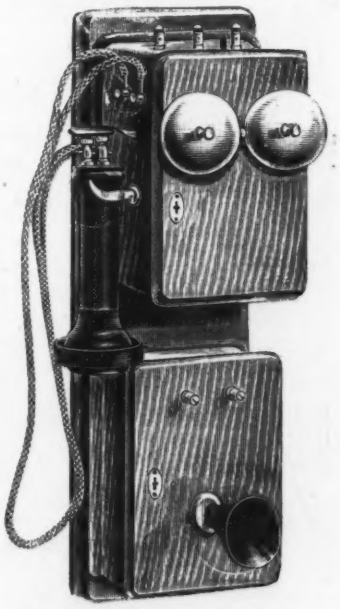


NEW INCANDESCENT LAMP.

carbon still maintains its initial candle power. None of those made has thus far burned out. Less than one cent's worth of platinum, it is claimed, is used in the disc.

Telephone Outfit.

We illustrate a telephone outfit manufactured by the Manhattan Electrical Supply Company, 36 Cortlandt street, New York, which, it is claimed, can be used on lines over 100 miles long under favorable conditions, and with most excellent results on lines under ten miles in length. The trans-



TELEPHONE OUTFIT.

mitter has a mouthpiece mounted on the door of the case, and the magnets are so arranged that the vibrations of the diaphragm are amplified and the speaker's voice reproduced at the distant station in an unusually clear and loud tone. The switch, when in normal position, cuts in the resistance of the call bell circuit, which is broken when the receiver is moved from the hook. By an ingenious device in wiring the resistance of the telephone is cut out while ringing the signal bell.

High Speed Automatic Engine.

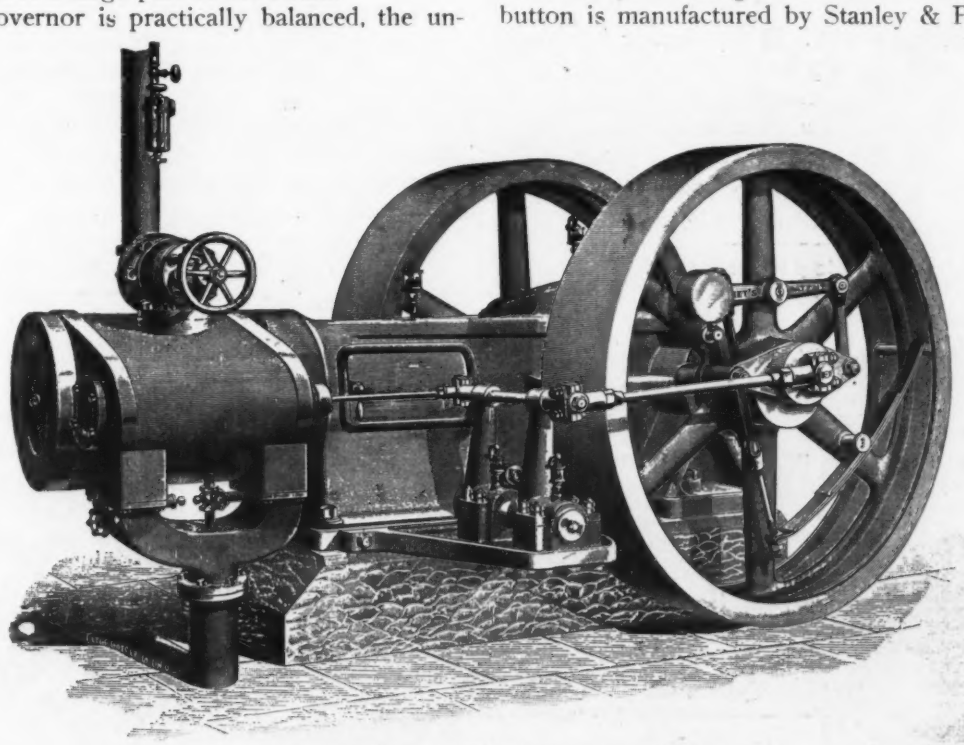
The engine we illustrate, manufactured by the Cooper-Roberts Company, Mt. Vernon, Ohio, is of the self-contained type, the frame being so formed as to allow the working parts to be encased, thus keeping them free from dirt, and preventing waste of oil.

The valve is of the hollow piston type, with self-expanding rings, making it steam tight; this type was adopted for the reasons that it is balanced, simple, requires less attention than any other balanced valve, and has no loose parts.

The wheel governor is of the well-known Sweet type, and consists of a single ball linked to the wrist-plate and connected to a spring by a metal strap, and so located and weighted as to counterbalance the wrist-plate and its attachments. When the speed of the engine reaches the point where the centrifugal force of the governor ball overcomes the resistance of the spring, the ball moves away from the centre of rotation, and, in doing so, carries the wrist-plate nearer the centre of the shaft, shortens its throw and the travel of the valve, and reduces the volume of steam admitted to the cylinder.

The ball is malleable iron, cast hollow, and loaded with lead and shot; being heavy, located some distance from the centre of the wheel, and running at a high velocity, it has great centrifugal force and requires a strong spring to resist it. This forms a powerful governor. The metal band connecting the governor ball to the spring is for the purpose of reducing the number of pieces, avoiding friction, and relieving the central pivot of a large part of the strain.

Unless a shaft governor is practically balanced, the unbalanced weight will constantly tend to move the whole system, more or less, at each revolution, which tends to wear the joints, and, under certain conditions, disturb the adjustment of the valve. Very few of the shaft governors are balanced, the eccentric or wrist-plate being an unbalanced element. The speed of the engine may be changed to a slight extent by increasing or reducing the amount of shot in the ball.



HIGH SPEED AUTOMATIC ENGINE.

An Indicating Push Button.

A novelty in the line of indicating push buttons, illustrated below, has recently been patented by Dr. C. D. Hunking, of New York City, in which a magnetic needle indicates by its movements the condition of the circuit. It is, in fact, a galvanoscope and push button combined and designed for use wherever the simple push button is needed. The magnetic needle with which it is supplied gives visual notice when the current passes so that the operator of the push button can see at a glance whether or not the circuit is in the proper condition. If the circuit is incomplete, the needle will remain stationary. If a constant current is passing, the needle will take an angular position and keep it until the current is broken. An interrupted current, as when an electric bell is in the circuit, will be indicated by a vibratory movement of the needle, which will deviate to the right or to the left, according to the direction of the current. The button is manufactured by Stanley & Patterson, 34 Frankfort street, New York, in burnished bronze metal, and can be made in all the ordinary materials, shapes and sizes.

INDICATING PUSH BUTTON.

A New Metallic Shade and Stand.

The accompanying illustration shows a new metallic shade and a new lamp stand, invented and manufactured by Mr. E. D. Cooke, Unity Building, Chicago. The shade is made of one piece of thin, polished and lacquered brass, and furnishes a handsome reflector, as well as an ornament to the electric lamp and socket. The shade is practically indestructible. No collar is necessary to be used with it, as the central clasps or spring fingers (the lower ones having curved ends, which clutch over the annular projection at the

bottom of the socket), hold the shade centrally and securely in place. This shade may be made of varied metals, such as copper, nickel-plate and aluminium, and the forms and outer rims may be fashioned in great variety.

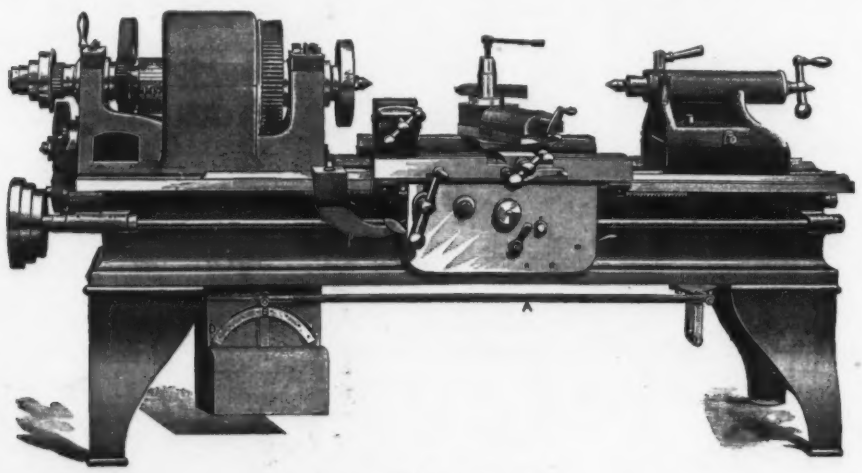
The stand is made to meet the demand for a light, neat

NEW SHADE STAND.

and detachable article, which will hold any electric drop lamp at such elevation or angle as may be convenient to the eyes. This stand is provided with a balancing cross-piece, at one end of which is a knob, and at the other a detachable spring wire tie clasp, which holds the socket securely in place. The set screws, front and back, allow the lamp and shade to be elevated and turned to any desired position.

Motor Driven Engine Lathe.

We illustrate herewith a lathe, manufactured by the Lodge & Davis Tool Company, Cincinnati, Ohio, in which the design includes an electrical motor, taking the place of the



MOTOR DRIVEN LATHE.

usual cone pulley. The lathe is reversed and the speed regulated by the movement of rod *A*. With the back gears arranged as usual, not only is a much wider range of speeds obtained than by a cone pulley, but a much more finely graduated speed. In fact, the speed may be anything from the highest to the lowest desired.

The armature is wound on a phosphor bronze spider with a carrier disc, which revolves freely on a spindle, the same as a cone pulley. It is surrounded by pole pieces inclosed in housing, the lower half of which is cast in one piece, with the head stock proper, to which it is substantially fitted and secured by means of four bolts. This construction forms an ironclad motor, entirely free from external magnetism. This is necessary in order to keep small particles of steel and iron from adhering to the lathe, making it impossible to keep the same clean.

Amongst the advantages secured by such an application of electricity are that tools may be placed independently of fixed conditions overhead, such as shafting, cranes, etc., and with regard to the arrangement best suited to handle the product most conveniently, and the operator has best control of his machine, especially when a variable speed is necessary. The motors, which are furnished by the Card Electric Motor and Dynamo Company, of Cincinnati, are simple, substantial and of sufficient capacity for the maximum load, free from complication and requiring very little attention in use.

Rigidity.

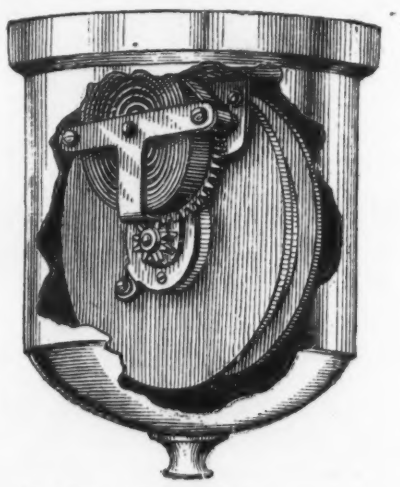
This is the oracular manner in which a semi-scientific American contemporary announces the fact that no known substance is perfectly rigid: "The form of no solid matter or metal can be said to be fixed, under the possibilities of pressure equal to the flow of its atoms toward a readjustment of an equilibrium necessary to maintain a permanent form, by equalizing or transferring pressures from a single direction to the multiple directions required for stability."—Lond. "Electrician."

Measuring Minute Temperatures.

Prof. Langley, of the Smithsonian Institution, has constructed a bolometer which is so delicate that a change of temperature of one-millionth of a degree is easily detected and measured.

Incandescent Lamp Adjuster.

The Blair lamp adjuster which we illustrate, manufactured by the Blair Lamp Adjuster Company, 509 McCague Building, Omaha, Neb., has been on the market for a little



LAMP ADJUSTER.

over a year, during which time it has met with much success. The adjuster is self-balanced, thus doing away with the annoyances incident to the use of window shade roller mechanisms, sometimes used for the same purpose. The construction is simple, there being no delicate parts to get out of order, and combines a double-pole fuse rosette. The adjuster is fastened to ceiling and presents a neat appearance.

New Books.

ON THE DEFINITIONS OF THE TRIGONOMETRIC FUNCTIONS. By Alexander Macfarlane, M. A., D. Sc., LL. D. Boston: J. S. Cushing & Co. 59 pages, 15 illustrations. Paper. Price, 50 cents.

This pamphlet is a reprint of a paper read before the Mathematical Congress at Chicago, Aug. 22, 1893. In it the author advocates the claims of a system of notation invented by himself, which applies to vector analysis. In a former paper, entitled "The Principles of the Algebra of Physics," the author introduced this notation, which is founded on the assumption that the trigonometrical functions, sine and cosine, are more simple in their nature than vectors. In the London "Electrician" of Dec. 9, 1892, Mr. Oliver Heaviside takes exception to this view, on the ground that vector algebra is far more simple and fundamental than trigonometry. In the present paper Prof. Macfarlane defends his position in replying fully to Mr. Heaviside and developing a set of definitions of the circular and hyperbolic functions which are logically consistent, and which bring together all these different quantities under a single theory. While many will doubtless think that Prof. Macfarlane has the best of the argument, those who do not will at least admit that he has made a valuable contribution to the theory of circular and hyperbolic functions.

REFERENCE BOOK OF TABLES AND FORMULAS FOR ELECTRIC STREET RAILWAY ENGINEERS. By E. A. Merrill, author of "Electric Lighting Specifications for the Use of Engineers and Architects." New York: The W. J. Johnston Company, 41 Park Row. Flexible morocco. Price, $1.00.

To a busy man the value of a reference book depends largely on the facility with which he can get from it the information he desires. In the larger works the labor involved in seeking out information, which perhaps is scattered through several sections and encumbered with examples and explanations already familiar to the engineer, is often exceedingly annoying, especially when many times repeated. It is the object of this text book, the author states in his preface, to avoid such annoyances, and meet a practical need by collecting and arranging in a concise, logical order those tables and formulas which are in constant use by the electric street railway engineer in making estimates, ordering material on construction work, etc. An examination of the work shows that this design has been consistentiy carried out. Superfluous examples and explanations have been excluded, as well as unnecessary extensions of formulas into tables when such extensions consist only in the simplest mathematical processes; as a consequence of this treatment, every element stands out in an unusually clean cut, terse form. Reference without the use of the index is facilitated by the arrangement of the matter, which follows a logical order, beginning with the details of the steam plant, and then taking up successively cars and their equipment, overhead work, track work and miscellaneous tables and formulas in constant use but only indirectly related to the main divisions.

Not only has considerable care been evidently taken in selecting and checking material compiled directly, but a number of original tables and formulas appear, especially in the sections on track and overhead work, which will save many calculations; further, many tables and formulas have been extended and modified to meet the conditions imposed in street railway work.

The practical arrangement of the book, its condensed style and convenient form will commend it to every street railway engineer. Every heading is in bold-faced type, which easily catches the eye as one glances over the page, thus materially aiding quick reference; as a further aid a complete cross index is added. The book is durably bound with flexible covers to lie open flat on the desk, and is of convenient size to carry in the pocket.

A POCKET-BOOK OF ELECTRICAL ENGINEERING FORMULAE. By W. Geipel and M. Kilgour. London: "The Electrician Publishing and Printing Company." 774 pages, illustrated. Price, $3.

Whether the title of this book is a misnomer or not depends in one respect upon the definition of electrical engineering. If we accept the definition sometimes offered, that electrical engineering comprises nine-tenths mechanical engineering and one-tenth electrical knowledge, the title would, with an exception to which we shall refer, be fairly correct provided it were supplemented with a substitute indicating that the book also contains references of greater or less length to about everything else in the constructive, physical and mathematical sciences. The exception above noted is in regard to the use of the word "formulae" as descriptive of a book that contains abbreviated treatises on hyperbolic functions, the calculus, differential equations, the slide rule (6 pages) on boilers, engines and their accessories (210 pages) etc. Engines, by the way, are classed as internal and external furnace engines, which upon examination we find to refer to gas and oil engines under the first head, and steam engines under the second; about seventy pages are devoted to this subject, consisting of matter appropriate enough in a text book on heat engines but rather out of place in a book of electrical engineering formulae. The same may be said of the lengthy section on boilers, with its instructions on design, testing, incrustation, riveting, management, etc.

In short, the book contains a miscellaneous collection of information which, though it be all intrinsically useful, is in great part out of place in a pocket book. A person does not refer to such a work for a monograph on hyperbolic functions, nor to study the theory of heat engines, nor to learn how to use a slide rule; he can get all of this information in a necessarily more satisfactory form elsewhere, and space is merely wasted in attempting to give, for example, the theory of differential equations in six small pages, or teach the management of boilers in the same space.

About 250 of the 774 pages of the book are devoted to electricity. In the first part of the volume are seventeen pages on units; then, sandwiched between "melting points" and "light," are thirteen pages on thermo-electricity, specific inductive capacities and resistance, after which are almost 500 pages on about everything but electricity. The electrical section proper consists of 210 pages, and is principally descriptive or explanatory, with occasional formulas and tables. The article by Dr. Sumpner on alternate current transformers is an excellent resume. The section on the economy of conductors (8 pages), which should be one of the most important in the book, is rather an essay on the subject with little or no direct practical bearing. In the section on the heating of conductors there are no tables of heating limits for different gauges of wire, but instead a table of values of $d^{\frac{3}{2}}$ and in the section on drop there are no wiring tables such as are universally used in the United States. Almost half of the space devoted to the incandescent lamp is given up to the consideration of the "smashing point," notwithstanding that the conditions which can render the "smashing point" of importance are rarely if ever present in practice.

While the book is therefore far from being what its title purports and lacking in many respects from an electrical standpoint, yet the great collection of data which it contains will render it useful to practising engineers. The mechanical execution is excellent in typography, presswork and binding.

Electric Traction in Switzerland.

The Bernese Oberland Railway Company is contemplating the substitution of electric traction for steam. The scheme is a very important one, comprising 200-h. p. locomotives, with ten trains on the line simultaneously.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, April 23, 1894.

GENERAL ELECTRIC.—Very little trading has been done in this stock the past week so far as the Stock Exchange record of sales shows. There has been a disposition to bull the stock on the general belief, as expressed in these columns last week, that everything bad concerning the corporation is now an open secret, and that the future must witness an early return to the accumulation of profits for distribution among stockholders; but the conditions prevailing in Wall Street have been contrary to the existence of a well sustained advance, and fluctuations have not been of material significance. In the meantime the General Electric people are getting more confident than ever in the future of the company. In the first place the management has inaugurated a reign of economy without affecting the efficiency of the real working force, that will result in an annual saving of thousands of dollars. In the Chicago office alone about 20 clerks have been dropped from the rolls in the past two weeks, and discharges of useless employes, who were kept on throughout the dull times for sentimental reasons, are being made in other centres. Moreover, a summary stop has been put to the practice of getting business at prices that do not admit of a profit. It is stated that the company is still slashing rates in the Western region, but no orders are any longer accepted that do not allow of a fair margin of profit. The policy of the company now is to do away with construction work, and rather sell standard machinery, on which the most money is to be made. The most gratifying piece of news that General Electric stockholders have heard in a long time is the announcement of President Coffin that "it is the intention of the company to issue, after a while, monthly or quarterly statements regularly." Nothing has yet been done towards making good the impairment in capital by reducing the capital stock. The board of directors has not even met yet to elect the two additional directors authorized at the annual meeting in Schenectady last week, and it is reported that nothing will be done for a week or two. There has been private discussion of the capital impairment matter by the directors and their counsel, but no tangible conclusion has as yet been reached. As soon as a feasible plan is broached, stockholders will be called together in special meeting to ratify the directors' programme. It will require practically unanimous consent on the part of the stockholders to make any plan a success.

WESTINGHOUSE ELECTRIC stocks continue to be freely bought in Boston, both for local and New York account. The chief buying is understood to come from the people who are close to the insiders and who know how steadily the company's business for the past three months has been gaining on all previous good records. In fact the present amount of business is said to be the best in the history of the Westinghouse company.

INTERIOR CONDUIT AND INSULATION stock woke up this week after a long rest, and sold at 40 and 41½. The friends of this concern say that it is an important factor in electric lighting of buildings on account of the safety of its methods. It is also, they add, to be a leading factor in equipping electric railways, and its business is now on a sound basis and making money. They confidently assert that, if anybody will buy a little of this stock and put it in his strong box, he is quite likely to see it selling at par before the end of this year.

EDISON ELECTRIC ILLUMINATING, of Brooklyn, has advanced to 104 on the outcome of the stockholders' meeting on Thursday, when it was determined, in accordance with the recommendation of the board of directors, to issue $500,000 new stock to present stockholders at par. This makes the total capital stock $3,000,000. The proceeds of the new stock issue are to be used to carry out the contract recently made in the city of Brooklyn for street lighting, and also to strengthen and extend the company's rapidy increasing business. Secretary Peabody says that substantial progress is being made in getting ready the plant to light the principal streets of Broklyn under the recently granted franchise. In 20 days the company will begin to set up ornamental poles similar to those on Fifth avenue, this city, as illustrated in a recent issue of The Electrical World, and the placing of all the wires underground will remove some 1,500 unsightly and disfiguring poles. By June 1 the current will be turned on the new lines. The company has placed the orders for additional machinery and apparatus to take care of this new street lighting. In view of these extensions and improvements the increase of capital stock is perfectly justifiable.

THE EDISON ELECTRIC ILLUMINATING, of New York, stocks and bonds continue in good favor as a result of the good showing for March, when nearly ¾ of 1 per cent. was earned on the stock, after allowing for the month's proportion of the annual fixed charges.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, has declared a dividend of 1½ per cent., payable May 1, to stockholders of record April 18.

ERIE TELEPHONE stock continues strong in Boston on buying that is knowingly for inside account. The present earnings are reported as being excellent, and the general financial condition is officially stated to be better than ever before in the experience of the company.

WESTERN UNION TELEGRAPH stock has advanced slightly. There is seemingly little interest in the stock just now. No inside support is manifested, the Gould boys being apparently more absorbed in making and breaking engagements and buying cup defenders.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref.	15	15	16
" " " " com.	15	15	17½
Edison Electric Ill., New York	100	100	103
" " " 1sts	—	107¼	107½
Edison Electric Ill., Brooklyn	100	104	105
" " " Boston	100	115	120
" " " Chicago	100	130	135
" " " Philadelphia	100	130	135
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	39⅞	40
" " " deb. 5's	—	85	86
Interior Conduit and Ins. Co	100	35	50
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	35	37½
" " " pref.	50	51½	52½
Western Union Telegraph	—	84⅝	84½
American Bell Telephone	—	188½	189

*Ex. dividend.

New Incorporations.

THE ST. LOUIS ELECTRIC BRAKE COMPANY, capital stock $5,000, has been incorporated by J. L. Black and others.

THE L. GUTHMANN COMPANY, of Chicago, Ill., capital stock $1,000,000, has been formed to manufacture telephones, torpedoes, etc.

THE ELECTRIC LIGHT COMPANY OF TIPTON, IOWA, capital stock $12,000, has been formed to operate an electric light plant. W. H. Treichler, J. H. Coatts, G. A. Garrett, P. R. Pine and J. T. Moffitt, all of Tipton, are interested.

THE HILLSBORO INVESTMENT AND ELECTRIC COMPANY, Hillsboro, Tex., capital stock $50,000, has been organized to generate electricity for various purposes, manufacture gas, etc. A. T. Rose, H. T. Ivy and E. G. S. Shields are the incorporators.

THE NORTHERN TELEPHONE AND TELEGRAPH COMPANY, Chicago, Ill., capital stock $10,000, has been formed to construct and sell telephone and telegraph systems and electrical apparatus. E. C. Preble, J. R. Keogh and T. H. Fitzgerald are the incorporators.

THE ELECTRIC TELEGRAPH COMPANY OF WESTCHESTER, N. Y., capital stock $10,000, has been formed for the purpose indicated in its title. E. I. Leonard, 158 East 97th street; J. J. Baker, Mt. Vernon; William Waldt, 273 South First street, Brooklyn, N. Y., are the promoters.

WALES CENTRE, N. Y.—The Buffalo Valley Telephone Company has been incorporated to build and maintain a telephone line in this vicinity. H. W. Richardson, of East Aurora; Dr. J. D. Wooster and Harry S. Gail, of Wales Centre, and W. R. Hoy, and William Richardson, of Strykersville, are interested.

THE WASHINGTON GAS AND ELECTRIC COMPANY, Washington C. H., Ohio, capital stock $100,000, has been formed to manufacture and furnish electricity and gas for light, heat and power. J. Penn, G. H. Clapp, M. Sharp, O. S. Hopkins, A. F. Hopkins and E. J. Light are interested.

THE BUTTE LIGHTING COMPANY, Butte, Mont., capital stock $1,000,000, has been formed to manufacture and deal in electric and gas lighting, etc. H. M. Byllesby, H. C. Levis, W. P. Johnson, St. Paul, Minn.; H. W. Turner, Missoula; J. W. Forbis, F. E. Corbett and J. R. Wharton, Butte, Mont., are interested.

THE DALLAS AND OAK CLIFF ELECTRIC RAILWAY COMPANY, of Dallas, Tex., has been incorporated with a capital stock of $200,000, to construct and operate street railways in those towns, to be operated by electric and other power. D. E. Green, J. N. Simpson, C. F. Carter, Dallas, Tex., and F. H. West, St. Louis, Mo., are interested.

HAZEL PARK, MINN.—The Hazel Park Electric Light and Power Company, capital stock $25,000, has been formed to supply light, heat and power by electricity. W. J. McWinney, Joseph Lafonze and H. A. Jansen are the promoters. Mr. J. Nosmo King, formerly chief electrician for the Oshkosh (Wis.) Electric Light Company, has been engaged as electrician and general superintendent.

TRENTON, N. J.—The Central Jersey Traction Company has been incorporated by J. H. Baldwin, of Orange; John H. Tingeley, of Rahway, and George G. Crosby, of New York, and they propose to connect New York and Philadelphia by a trolley line, to touch Elizabeth, New Brunswick, Newark and other points. Frank A. Magowan, of Trenton, is president, and J. H. Baldwin, of Newark, N. J., is secretary.

TRENTON, N. J.—A large Pittsburgh concern has incorporated in Trenton, and is represented by Frank S. Katzenbach, Jr., of Trenton, N. J. Among those interested are Charles C. Burton and Curtis Grubb Hussey, of Pittsburgh; Louis Edward Holden, of Beloit, Wis., and George McMurtry Ludlow, of Chicago, Ill. They will engage extensively in the manufacture of electric appliances in Pittsburgh, Pa.

THE INTERNATIONAL ELECTRICAL SUPPLY COMPANY, of Detroit, Mich., has been incorporated with a capital stock of $500,000.

THE CHIHUAHUA ELECTRICAL AND POWER COMPANY has been incorporated by J. B. Hood and others. The capital stock is $100,000.

THE WISCONSIN ELECTRIC DYNAMO COMPANY, Milwaukee, Wis., capital stock $50,000, has been formed to manufacture dynamos, erect electric plants, etc. The promoters are G. Podall, J. M. Brandmueller and J. B. Zann.

THE WATERLOO LIGHT AND POWER COMPANY, Waterloo, N. Y., capital stock $50,000, has been created to supply electricity for various purposes. F. Bacon, P. M. Kendig and A. G. Mercer, of that place, are the promoters.

THE LOCK HAVEN ELECTRIC RAILWAY COMPANY, Lock Haven, Pa., capital stock $100,000, has been formed to build and operate a railway. The organizers are S. Christ, T. H. Harmon and J. H. Fredericks, Lock Haven, Pa.

THE PASADENA AND LOS ANGELES ELECTRIC RAILWAY COMPANY, Los Angeles, Cal., capital stock $500,000, has been formed to construct and operate railways by electricity or otherwise from the one place to the other. The incorporators are P. M. Green, H. W. Magee, E. C. Webster, L. P. Hanson, F. E. Beach, Pasadena; William Lacey, E. P. Clark, Los Angeles.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 23 1894.

QUEEN & CO., of Philadelphia, have established a branch at 116 Fulton street.

THE STORAGE BATTERY SUPPLY COMPANY has removed its offices to 239 East 27th street, New York.

H. B. COHO & CO., 203 Broadway, New York, contractors for the Mather Electric Company's apparatus, sold last week two 120-kw. and one 10-kw. Mather generators.

THE LAW BATTERY COMPANY, 85 John street, New York, still keep apace with the electrical fraternity. Favorably known for so many years, their product has constantly kept in the front rank.

MESSRS. DOUBLEDAY, MITCHELL & CO., 136 Liberty street, New York, are handling the Metropolitan electric fan motor, manufactured by the New Haven Insulated Wire Company, of New Haven, Conn.

THE ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING COMPANY has moved its office from the Edison Building, 44 Broad street, New York, to the Monroe Taylor Building, 39 Cortlandt street.

MR. HARRY W. COLBY, New York manager for the Holtzer-Cabot Electric Company, of Boston, Mass., has moved his office from 143 to 114 Liberty street. Mr. Colby reports quite a number of sales of fans manufactured by his company.

MR. CHARLES BLIZARD, representing the Electric Storage Battery Company, of Philadelphia, Pa., has returned from an extended Western trip in the interest of his company. Mr. Blizard reports business in the West as being prosperous.

MESSRS. McLEOD, WARD & CO., 91 Liberty street, New York, manufacturers of the Kinsman desk and portable lamp, have appointed agents in all of the principal cities in the United States, from whom large orders are daily being received.

J. JONES & SON, recently removed to 67 Cortlandt street, New York City, are still selling the stock of the A, B, C Company. Messrs. Jones & Son will keep in stock the Columbia lamps, and will continue to supply the demands for their well known anti-thunderbolt insulating paper.

MR. D. P. FITZGERALD, JR., formerly with the E. S. Greeley & Co., is now manager of the Enterprise Electric Equipment Company, 298 Broadway, New York. Mr. Fitzgerald's company, while doing a general line of electrical construction work, also deals extensively in telephones.

MR. DAVID CHALMERS, formerly connected with the A, B, C Company, and recently manager for the receiver of the above named company, has accepted the position of manager of the New York office of the Holtzer-Cabot Company, of Boston, Mass. This company will occupy the ground floor of 114 Liberty street, and will carry a full line of specialties manufactured by it.

THE BROOKLYN ALDERMANIC COMMITTEE ON LAMPS AND GAS has received a petition for a franchise from the Kings County Electric Light and Power Company, represented by Lawyer Mirabeau L. Towns, T. S. Quinn and James T. Lewis, with a capital of $250,000. The matter was considered in executive session, and will be reported upon later.

MR. LOUIS J. AUERBACHER, formerly connected with the E. S. Greeley & Co., has accepted the position of secretary and general manager of the Automatic Electrical Specialty Company, 136 Liberty street, New York. While the company will act as general electrical contractors, and also deal in electrical supplies, its specialty consists of the Hoggson automatic electrical time stamp.

THE JOSEPH DIXON CRUCIBLE COMPANY held its annual meeting of stockholders at its offices in Jersey City on April 16. The vote of the shareholders was the largest ever cast, and was a decided compliment to the board of managers. In the organization of the board Mr. E. F. C. Young was elected president, John A. Walker vice president and treasurer, and George E. Long secretary. The Dixon company was founded by Joseph Dixon as early as 1827, and was organized as a stock company in 1868.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., April 19. 1894.

BOSTON PAYS $25,840.07 for rental and tolls for 707 telephones.

THE BOSTON INCANDESCENT LAMP COMPANY has been notified of an injunction granted against it by the United States Circuit Court, Judge Colt, on motion of the Edison Electric Light Company.

MR. J. J. GATES, of the Royal Arc Electric Light Company, favored this office with a call this week. He was, as always, in the best of spirits and full of business. Who ever saw him otherwise? He is the prince of good fellows, and none can boast of greater popularity.

THE AMERICAN BELL TELEPHONE COMPANY has not yet received authority to increase its capital from $20,000,000 to $50,000,000. The bill for the same in the Massachusetts House of Representatives has been tabled to await a coming revision of the State corporation laws.

MR. T. H. BIBBER has accepted the New England agency for Charles E. Chapin, of New York, with headquarters at 620 Atlantic avenue, Boston. Mr. Bibber has a large circle of friends and acquaintances in this territory, and will undoubtedly do a good business. We wish and predict for him success.

EAST WEYMOUTH, MASS.—The citizens of this town held a meeting to discuss an extension of the Quincy and Boston Electric Railway from North Weymouth. The railway company stated that a road would be built if sufficient financial support could be obtained from the citizens, and a canvassing committee of citizens was appointed to obtain subscriptions for the stock.

MR. P. M. REYNOLDS, treasurer of the Brown Electric Company, of Boston, is a great grandson of Paul Revere, who figured so prominently in the historic battles of Lexington and Concord, Mass. Mr. Reynolds' connection with this honored patriot is known to but few of his electrical friends, as he is a modest man, but he undoubtedly felt considerable pride over it upon the occurrence of the 119 anniversary of these battles on the 19th inst., and which was observed for the first time as a legal holiday in Massachusetts, and celebrated in a most magnificent and appropriate manner.

MR. WILLIAM LEE CHURCH, of Westinghouse, Church, Kerr & Co., is at present sojourning in the Bahamas for the purpose of recruiting his health, which became impaired considerably because of a recent attack of the grip and close application during the past winter to the conduct of his business. Mr. Henry J. Conant will look after the interests of the company during Mr. Church's absence.

THE USE OF THE TELEPHONE in connection with the fire alarm service, as an adjunct to the boxes, which was introduced by the Boston fire commissioners last fall, was availed of last week for the first time, and Chief Webber states that it worked admirably, and placed him in direct communication with the fire alarm office in the city hall dome. Heretofore he has had to send his orders by the Morse telegraph, each box having an operating key. This is a combination which admits of any one opening the alarm box and pulling the hook, but the telephone box is separated from the alarm box.

"THE ELECTRIC POTENTIAL."—The efforts to form an electric organization in Boston proved successful at the dinner held at Young's Hotel last Friday evening, the 20th inst. It will be known as "The Electric Potential," will be governed by the most simple of by-laws, and the expense of membership will be but $2 as an entrance fee and $1 per annum as dues. Mr. C. W. Holtzer, who started the movement, was elected president of the organization. The other officers elected are: Vice presidents, Col. E. H. Hewins and Frank Ridlon; secretary, A. C. Shaw; treasurer I. H. Farnham. Over 20 names were enrolled as members at the dinner. Mr. W. J. Denver acted as chairman of the meeting.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports the following sales of apparatus outside of its railway business for the last ten days: Massachusetts Hospital for the Insane, Northampton, Mass., one 350-light and one 600-light dynamo; Eastern Yacht Club, Boston, Mass., one 250-light dynamo; Wayne county house, Wayne, Mich., two 20-kw. direct connected dynamos; S. N. Blake, Elmira, N. Y., one 350-light dynamo; Sherman & Kopf, Deroit, Mich, one 250-light dynamo; George Whitney Woolen Company, South Royalston, Mass., one 100-light dynamo; Syracuse "Herald," Syracuse, N. Y., one 250-light dynamo; Union Central Life Insurance Building, Buffalo, N. Y., one 450-light dynamo and one 250-light dynamo;

Patent Cereal Company, Geneva, N. Y., one 150-light dynamo; Crane Bros., Westfield, Mass., one 50-light dynamo; Henry Reinhardt, New York City, one 150-light dynamo; Boston Ferrule Company, East Boston, Mass., one 50-h. p. slow speed motor; Phelps Publishing Company, Springfield, Mass., one 50-h. p. slow speed motor; also in Springfield two 15-h. p. and one 1-h. p. motors; sixteen other motors from 1 to 15 h. p. in various places.

Pittsburg Notes.

PITTSBURG, April 21, 1894.

THE SECOND AVENUE TRACTION COMPANY is now reconstructing its entire line from Pittsburgh to Glenwood, a distance of four miles.

THE PITTSBURGH, ALLEGHENY AND MANCHESTER TRACTION COMPANY contemplates putting on the lines of its system a large number of open cars for the summer traffic.

THE WESTMORELAND ELECTRIC COMPANY, of Greensburg, Pa., will double the capacity of its plant, which will necessitate expenses aggregating $12,000. The company also intends to introduce the system of selling the electric current by meter.

A CHARTER was granted to a number of well known capitalists of this city for what may be termed the first long distance electric railway in Western Pennsylvania. The company is called the Allegheny and Butler Railway Company, and it is proposed to construct a railway 50 miles long. The capitalization is $300,000, and the directors are F. Gwinner, Jr., E. W. Gwinner, W. B. Rhodes, Charles K. Hill and W. I. Mustin.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building CHICAGO April 14, 1894.

MILWAUKEE, WIS.—Superintendent Kleinsteiber, of the Police Alarm Telegraph system, states that the underground system will be extended this summer.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has decided to again supply the old reliable Packard lamp, and to carry a more extensive stock than has ever been carried before in Chicago. The stock will be well assorted and complete, running in sizes from 5 to 500 c. p.

THE METROPOLITAN ELECTRIC COMPANY, 186 Fifth avenue, reports that N. I. R. wire is being put into the Leland Hotel, the famous old hostelry at the corner of Adams street and Michigan avenue, Chicago, and that the Stock Exchange Building of the same city is the latest to adopt "Xntric" switches throughout. The Old Colony Building has these switches also, and they are found to be entirely satisfactory.

THE GENERAL ELECTRIC COMPANY has removed its offices from the old Edison General headquarters, at 173 Adams street, to the Monadnock Building, on acount of more room being required for the large stock of goods that this company carries, and the better facilities needed for making shipments. The new storehouse is located on the line of the Wisconsin Central, Chicago & Great Western and Baltimore & Ohio railways, and is splendidly situated for shipping purposes; the company is therefore in shape to make even prompter shipments than heretofore. The removal of the stock to this new storehouse left the Adams street building partially vacant, and other quarters for office purposes were sought, arrangements finally being made for a portion of the tenth floor of the Monadnock Building. The rooms occupied, 1042 to 1056 inclusive, take up the whole of the south end, and are fitted up handsomely, so that they now have one of the finest suites in the building, which means one of the finest in Chicago.

English Notes.

(From Our Own Correspondent.)

LONDON, England, April 11, 1894.

AN ALTERNATING CURRENT TRAMWAY.—The well known Creusot works will show an electric tramway on the alternate current system at the forthcoming exhibition at Lyons.

ELECTRIC RAILWAY ENTERPRISE IN LONDON.— A bill now before Parliament, for running an electric railway from the City to Epping Forest, has the honor of being the best opposed bill in the session.

THE CITY LIGHTING.—The gas lamps in the main streets of the city have now all been removed. The City company announces that it has now laid its mains in 406 "streets, courts, lanes, etc.," within the city boundaries, and expects to have mains everywhere by the end of May.

ELECTRIC RAILWAY IN SWITZERLAND.—The Bernese Oberland Railway Company is, it is stated, contemplating the substitution of electricity for steam. As this line employs locomotives of 200 h. p., and there are, as a rule, some 10 trains simultaneously on the track, the job will be a fairly big one.

PROPOSED ELECTRIC TUBULAR RAILWAY IN PARIS.—The French Government, at the suggestion of the Minister of Public Works, has placed a bill before the Chamber of Deputies empowering the Paris Municipal Council to construct a tubular electric railway connecting the Bois de Boulogne with the Bois de Vincennes.

News of the Week.

Telegraph and Telephone.

CORDELE, GA.—F. J. Moore is about to establish a telephone exchange.

LEXINGTON, KY.—Percival Moore and others are to start a telephone exchange.

MT. STERLING, KY.—A telephone exchange is to be established by Adam Baum.

ORANGEBURG, S. C.—L. H. Wannamaker and others are to establish a telephone exchange.

TEMPLE, TEX.—The Taylor Telephone Exchange has been formed by J. D. Seiders and others.

AUGUSTA, GA.—D. J. Murphy will be the manager of the new telephone company now forming.

SALEM, VA.—A. F. Wolfenden has been granted an exclusive franchise for a telephone exchange, and will begin work at once.

RENVILLE, MINN.—The Renville Telephone Company will extend its lines this spring. McGregor Brothers & Co. will also build a line from Hector.

STAUNTON, VA.—The Monterey and Staunton Telephone Company has been organized by J. C. Matheny and others to construct a telephone line.

THE TAMPA AND MANATEE TELEPHONE AND TELEGRAPH COMPANY, Tampa, Fla., has been organized with F. A. Salomson as president, J. H. Knight, vice president, and S. A. Padgett as secretary and treasurer.

Electric Light and Power.

PALATKA, FLA., is considering the question of electric lighting.

RIPON, WIS.—The Council is investigating the matter of municipal lighting.

WAVERLY, OHIO.—An electric light plant, costing $15,000, will be constructed.

MT. STERLING, KY.—An electric light plant is to be erected by the local government.

DELANO, MINN.—Citizens have voted to issue $10,000 in bonds for waterworks and electric lights.

LEXINGTON, KY.—The Queen and Crescent Railroad Company will put an electric plant in its yards.

HENDERSON, MINN.—Taxpayers of Henderson have voted to issue bonds to purchase an electric light plant.

EATONTON, GA.—The Eatonton Electric Light Company is being organized to establish an electric light plant.

SANDERSVILLE, GA., wishes estimates for an electric light plant, which may be addressed to the mayor of that city.

PAW PAW, MICH.—A Mr. Farley is getting plans for an electric light plant for Paw Paw.

DETROIT, MICH.—The lighting commissioners estimate that $174,000 will be needed during the coming year.

FREELAND, PA.—The Freeland Light and Power Company will at once erect a plant near the waterworks.

COLLIERVILLE, TENN.—E. K. Leake desires estimates for a dynamo of 200 to 300 incandescent lights capacity, with all necessary fixtures.

MOUNT STERLING, KY.—Bids will be received by the Council for the construction of an electric light plant. Adam Baum is mayor.

LONDON, ONT.—Tenders will be received to May 15 for electric lighting for the streets of London. A. Ormsby Graydon is city engineer.

EASTON, PA.—The secretary and superintendent of the water and light department have been instructed to call for bids for another dynamo.

FLORILLA, GA.—Capt. W. F. Smith is contemplating installing an electric lighting plant, operated by water power, to light Florilla and Indian Springs.

TENVILLE, GA., is desirous of having estimates on the erection of an electric light plant. Communications should be addressed to the mayor.

LE ROY, N. Y.—The village Board of Trustees has voted to lay on the table the petition of Charles F. Prentice for a franchise for incandescent electric lighting.

WASHINGTON, D. C.—The War Department has not yet reported to the district commissioners in the matter of the proposed electric light plant at Great Falls.

THE HOLLY SPRINGS ELECTRIC LIGHT AND ICE MANUFACTURING COMPANY, Holly Springs, Miss., is being organized by J. G. Leach and others.

LANCASTER, MASS.—Mr. H. T. Gibbs can be addressed concerning the electric light station and the electric railway power station, which is to be built there.

WILLIAMSPORT, PA.—Sealed proposals will be received to noon, April 30, for lighting the streets of Williamsport for five years with gas or electricity or otherwise. William I. Dreisbach is city clerk.

SAVANNAH, GA.—The Brush Electric Light Company has bought land adjoining its present plant, and will spend $50,000 for improvements, to include new engines and boilers.

JAMESTOWN, N. Y.—It has been decided to use the town plant for commercial and street lighting, the Board of Public Works having been instructed to prepare plans and specifications.

EVART, MICH., has voted for the establishment of an electric light plant, and will want a 75½ or 100-h. p. engine, arc and incandescent dynamo, which have not yet been contracted for.

WILMINGTON, DEL.—The electric lighting contract with the Wilmington City Electric Company expires Jan. 1, 1895, and there will then be a competitor in the field—the Wilmington Light, Heat and Power Company.

LEXINGTON, N. C.—The Lexington Electric Light and Power Company has been organized with J. D. Neal as president, C. M. Thompson, vice president, and J. M. Riley, secretary, and a complete plant for both arc and incandescent lighting will be erected.

ALTOONA, PA.—The Edison Electric Light Company has bought the property in the Fifth Ward, located between the Pennsylvania Railroad, the branch railroad, Union avenue and Fred. Ramey's coal yard, and will erect there a large electric lighting plant.

COLUMBIA, S. C.—The Columbia Cotton Mill is to be operated by some 17 65-h. p. induction motors, taking their power from two 650-h. p. 500-volt three-phase generators, operated by water power some 300 yards distant from the mill. This plant is now being installed by the General Electric Company.

The Electric Railway.

OVID, MICH.—Taxpayers of Ovid have voted to issue bonds for electric lights.

ANDOVER, MASS.—The South Side Street Railway has been granted location on certain conditions.

EAST ORANGE, N. J.—The matter of awarding a contract for street lighting has been laid over to April 30.

CINCINNATI, OHIO.—The Mount Adams Street Railway line will build to the village of Oakley this summer.

WATERLOO, N. Y.—An electric road is to be constructed by the Seneca and Waterloo Electric Railway Company.

NEW BRITAIN, CONN.—Four miles of new electric road will be built by the Central Electric Light and Railroad Company.

MILWAUKEE, WIS.—The Milwaukee Street Railway Company will extend the Farrell avenue and Flotson place line to the Park.

ANDOVER, MASS.—The Lowell, Lawrence and Haverhill Street Railway has applied for right to lay tracks and operate a street railway.

HOLYOKE, MASS.—The People's Street Railway Company is to build a 9½ mile electric railway. Contracts have not yet been awarded.

BRISTOL, ME.—Negotations are under way for the construction of an electric road from Pemaquid to Damariscotta, a distance of 13 miles.

FRIEDENSVILLE, PA.—James A. Endy, of Friedensville, is petitioning the Rapid Transit Company to extend its lines to Salisbury and Saucon.

GALESBURG, ILL.—A franchise is being asked by the Galesburg Motor Company for right to control and maintain an electric railway. W. Secord is president.

PLAINFIELD, N. J.—Messrs. Runyon & Moffett are contemplating the extension of the street railway to Netherwood, and are getting consents of property owners.

NORRISTOWN, PA.—The Norristown and Chestnut Hill Railway Company has been granted permission to build a line to be extended to Philadelphia within 14 months.

AUBURN, ME.—The special committee of the City Council has reported in favor of granting a franchise to the Lewiston and Auburn Railway Company upon certain conditions.

KANSAS CITY, MO.—The Kansas City Cable Railway and the Kansas and Independence Rapid Transit Company have consolidated. L. C. Kurthoff and Webster Withers are interested.

MONTGOMERY, ALA.—The street railway company has ordered 15 motors and car equipments of the General Electric Company, and is at work equipping all its lines for electric cars.

LOWELL, MASS.—The House of Representatives has passed to be engrossed the bill allowing the Lowell and Suburban Street Railway Company to extend its tracks and to use electricity.

DUNKIRK, N. Y.—The bill authorizing the Dunkirk and Fredonia Street Railway Company to furnish incandescent light and power to business houses and residences has passed the Senate.

WATERBURY, VT.—The Mt. Mansfield Electric Railroad is to be built, but it is not yet contracted for, and equipments will be wanted. Mr. M. H. McIntosh is the person to address for particulars.

MIDDLETOWN, CONN.—Mayor Vinal has vetoed the ordinance granting to the Middletown Horse Railway Company the right to equip with electricity. It will come up again in modified form.

WEST SENECA, N. Y.—The petition of the Crosstown Railway Company, of Buffalo, for right to build and operate a street railway in West Seneca will be heard at the town meeting, May 1, at 2 P. M.

OPELIKA, ALA., is to have an electric railway seven miles long, extending to Auburn. Two motor cars and a generator will be used, and power will be furnished by the Opelika Electric Light and Power Company.

PHILADELPHIA, PA.—It is stated on good authority that the Penn Traction Company, of which ex-Senator John J. Patterson, of Lancaster, is the prime mover, will go ahead with its proposed trolley line from Harrisburg to Philadelphia.

LOCK HAVEN, PA.—The Lock Haven Railway, capital stock $100,000, has been chartered, and arrangements will be made to build the line at once. J. H. Fredericks, T. H. Harmon and L. M. Patterson are the committee to make contracts.

BRADFORD, PA.—The Council has received a petition for right to build and operate an electric street railway from L. Emery, Jr., C. P. Collins, L. E. Hamsher, W. R. Weaver and C. C. Melvin, and the petition was referred to the joint street committee.

CLEVELAND, OHIO.—It is proposed to build an electric road at a cost of $300,000, to be called the Cleveland and Akron Electric Railway. Hon. Martin Dodge, of Cleveland; Charles D. Everett, of Cleveland, and F. N. Wilcox, of Akron, are the promoters.

HARRISBURG, PA.—The Carbon Linestone Railroad Company, capital stock $20,000, has been chartered to build a two-mile road in Lawrence County. The directors are James H. Reed, of Pittsburgh; James H. Bailey, of Allegheny, and John G. Robinson and Rawdon Evans, of Pittsburgh.

ST. PAUL, MINN.—In the matter of placing an electric light plant in the court house, five plans were submitted, but it was decided to reject all bids and call for new plans and specifications, and contracts will then be let.

EAST WEYMOUTH, MASS.—President John R. Graham, of the Quincy and Boston Railway, is anxious to extend the road to East Weymouth, and offers to do so if residents will take $20,000 in stock, being one-half the estimated cost.

WAKEFIELD, MASS.—There was so much opposition to the petition of the Wakefield and Stoneham Street Railway Company for a franchise for a road on the Lake Drive that it is likely the matter will be submitted to a town vote.

SOUTH MOUNT VERNON, N. Y.—The Board of Trustees of South Mount Vernon has granted a franchise to the Union Railroad Company, of New York, to lay tracks on Third street, which will make 18 miles of road from West Farms.

NEW HAVEN, CONN.—A special to the New York "Evening Post" states that a syndicate has bought King's Island, and will dam the Connecticut River some 12 miles above Hartford, to supply towns and cities in the lower Connecticut valley.

ALBION, N. Y.—The Rochester "Times" is authority for the statement that right of way has been secured for the proposed one-rail electric line from Waterport to Lakeside, and that the company will erect a power house at Waterport on land already purchased.

FREEPORT, ILL.—R. S. Brown, of Easton, Pa., has bought the street railway on behalf of a syndicate composed of himself, Congressman Haines, of New York, and Congressmen Mutchler Shibley, of Pennsylvania, and they will convert the road into an electric line.

ENFIELD, CONN.—A special to the New York "Recorder" states that Terry's Island, opposite Enfield, Conn., has been sold to a syndicate, which will build a dam there to develop power for supplying towns with electricit. C. Douglas, of Windsor Locks, Conn., will give details.

ORANGE, N. J.—Thomas Nevins & Sons, of Orange, N. J., have signed a contract for the purchase of the entire street railway system, 80 miles, of which 30 miles are trolley in the city of Detroit, Mich., and they will organize a $10,000,000 company to develop the system and equip entirely with trolleys.

MANCHESTER, N. H.—It looks as if the proposed electric road for Manchester would soon become an actuality. General Williams, of Manchester, and Engineer William McQuestion, of New York, have been going over the proposed route, but they decline at present to give detailed information.

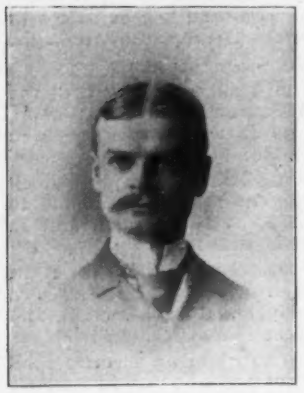
ATLANTA, GA.—The Atlanta Traction Company has been reorganized with Dayton Hall, president; W. C. Hall, vice president, and W. L. Sedden, secretary. The reorganized company will build additional lines, and has closed contracts with the General Electric Company for 10 motors and car equipments.

NEW ORLEANS, LA.—The Traction Company is pushing forward the work of equipping its lines with all possible speed. Sufficient money has been secured to pay off all indebtedness. James H. Maury, of New York, is president, and H. M. Littell, general manager. Within 90 days it is anticipated that four of the lines will be in operation.

NASHVILLE, TENN.—The electric railway has been placed in a receiver's hands. To satisfy an indebtedness of $9,000 the road will have to be sold. The United Electric Railway was sold at auction April 18 to Nathaniel Baxter, Jr., representing the bond-

holders, for $138,500. The road is 46 miles long, and the purchasers assume the bonded indebtedness of $1,516,000.

Personal Notes.

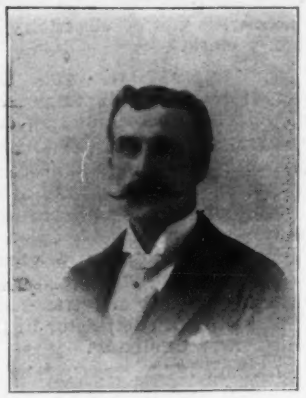


MR. D. A. ANDREWS, JR., the vice president and treasurer of the Pettingell-Andrews Company, was born in Boston and has always resided in that city. After completing his studies he connected himself with the well known importing and commission firm of Stoddard, Lovering & Co., of Boston, where he received the very best business training. The business principles instilled by this firm he has always carefully observed and practiced, and they have contributed largely towards the success he has achieved for himself in the electrical business. His father, whose full name he bears, who laid the foundation for the present success of this company through his excellent financial management, was one of the most thorough of business men, so that it may be said that Mr. Andrews inherits his business ability. As is generally known, the Pettingell-Andrews Company succeeded the firm of F. E. Pettingell & Co., by which it was known when Mr. Andrews connected himself with it. He commenced at the "bottom round of the ladder," thoroughly informing himself of every detail of the business, and rapidly earned promotion, being admitted finally as a partner in the firm. In June, 1890, the business was incorporated as the Pettingell-Andrews Company, and Mr. Andrews was elected to the responsible position of vice president and purchasing agent. Upon the death of his father, about a year ago, he was elected to his present position, and has shown himself to be possessed of excellent financial ability and business judgment.

MR. C. B. PRICE was born in Salem, Mass., where he still lives. After leaving high school he entered the drug business, in which he acquired valuable business knowledge. and experience. He left this business to accept a position with the then F. E. Pettingell & Co., about the same time as Mr. Andrews. He was ambitious from the start, and was willing and eager to do anything that would familiarize himself with the business, finally securing an important clerkship in the firm, advancing himself to the position of principal salesman, and gaining admittance into the firm at the same time as Mr. Andrews, March 1, 1890. Upon the incorporation of the business into the Pettingell-Andrews Company, Mr. Price was made secretary, and upon the reorganization of the company after the death of Mr. Andrews, Sr., he was elected to his present position, for which he possesses unusual abilities.

MR. FRANK X. CICOTT, manager of the railway department, was born in Detroit, Mich., attended private school there, and went to San Francisco, Cal., in 1867, via Panama, before the completion of the transcontinental railroad. He graduated at the Pacific College in 1869. He traveled extensively in Mexico, Central America and China in 1871, and made two trips to Japan in 1872. He entered commercial life in San Francisco in the latter part of 1872, and in 1874 he was appointed chief coiner of the mint of the United States at San Francisco, by President Grant. During his administration as coiner, from 1874 to July, 1881, $237,000,000 was coined, being mostly the product from the Bonanza Mines, at Virginia City, Nev. Retiring from political life, Mr. Cicott resumed commercial pursuits, acting from 1882 to 1889 as resident agent on the Pacific coast for Holmes, Booth & Haydens, electrical supplies, and also for various railway material, etc. Leaving the Pacific coast he located in Chicago to accept the management of the railway department of the Electric Merchandise Company, of that city. In 1891 he started a tramway and railway paper in London, England, called the "Railway World," and still continues as a shareholder and director on the board of the English publishing company. In January of this year he accepted his present position of secretary and general manager with the Pettingell-Andrews Company.

MR. J. E. WILSON, the traveling salesman of the company, was born in Salem, Mass., received a good common school education, and commenced his business career with the Telegraph Dispatch Company of Boston, which was finally merged into the New England Telephone and Telegraph Company. He was with this company for eight years, gradually working himself up to the position of inspector and central office electrician. Leaving this company, he connected himself with the Financial Telegram Company, of Boston, now known as the United Telegram Company. He held the position of superintendent of this company for about three years. He then went to Chicago as representative of J. A. Grant & Co., of Boston, selling the well known McIntosh & Seymour engines, in which he was very successful, installing several plants, among which was one of 600 h. p. in the Wisconsin Central depot. Returning to Boston in 1891, Mr. Wilson became identified with the Eastern Electric Supply Company, of that city, and when this company was merged into the Pettingell-Andrews Company he went with it, and has retained his connection ever since. It will thus be seen that Mr. Wilson is an "old timer" in the electrical business.



Miscellaneous Notes.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, Ohio, is preparing a new catalogue, which will announce a mathematical course commencing with algebra and going through the calculus, and also comprising advanced studies connected with various specialties.

COST OF INCANDESCENT LIGHTS.—The Edison Illuminating Company, of Milwaukee, has adopted the following schedule of rates: One cent per hour for each 16-candle power lamp, subject to a discount of 25 per cent. on monthly bills of $25, and a discount of 50 per cent. on monthly bills of over $50. The minimum charge to any consumer will be $1 per month. The discount allowed heretofore was 5 per cent. on all bills up to $50, and 10 per cent. on bills of more than that amount.

THE ASSOCIATION FOR THE PROMOTION OF PROFIT SHARING, of which Carroll D. Wright, United States labor commissioner, is president, General F. A. Walker one of the vice presidents, and the ubiquitous R. R. Bowker one of the directors, has issued a circular letter to employers and employes inviting their attention to the subject of profit sharing. Applications are invited for full information concerning the history and the results of the system, as it is now in operation in many establishments, small and large, in Europe and the United States. The secretary is Nicholas P. Gilman, 25 Beacon street, Boston.

THE OTTUMWA ELECTRIC RAILWAY, of Ottumwa, Iowa, has adopted a plan originated by its president and general manager, Mr. W. R. Daum, by which frequent patrons of the road can be given reduced rates that would not be available for the occasional rider. The company issues coupon books containing 100 tickets each, offering one book for $4.50, three for $12.90, five for $20.25, ten for $38. In addition to this the company agrees that the cover of each book, if presented at the office, will be accepted toward the purchase of another book at the following values: 25 cents if presented within 90 days, 50 cents if presented within 60 days, 75 cents if presented in 30 days from the date of issue. By this means those people who ride most frequently obtain the lowest rates. The company has limited this offer until May 15, and as an additional inducement further agrees that if 1,000 books are sold before that date the time will be extended 30 days for the acceptance on the covers at the values marked on all books sold by that date. The system is said to be working very successfully.

THE COMMERCIAL CABLE COMPANY'S THIRD CABLE.—The steamer Faraday left London on April 1 with about 500 miles of the Commercial Cable Company's new cable, the destination being Waterville, Ireland, from which she will lay about 100 miles of shore cable and buoy it, and then proceed to Fox Bay, Canso, N. S., and will lay about 400 miles more of shore cable there; then she will return to London, where she will take on board the balance of the cable, the laying of which will probably be completed by July 1. The conductor consists of 500 pounds of pure copper per knot and 320 pounds of guttapercha dielectric per knot. It has the largest core of any cable ever yet laid. The material consumed consists of 1,100,000 pounds of copper, 800,000 pounds guttapercha, 9,500,000 pounds steel wire, 1,300,000 pounds jute yarn and 1,800,000 pounds compound. A large portion of the cable has been supplied by John A. Roebling's Sons. The guaranteed speed of the cable is 33⅓ greater than the present Commercial cables. The length is 2,200 nautical miles. Specially heavy types will be laid in the vicinity of the fishing grounds off Nova Scotia and Newfoundland. The contractors were Messrs. Siemens & Bros., of London, England.

POWER AT NIAGARA.—In a letter to a daily contemporary, a writer states that there is now in course of development about the great falls of Niagara, the enormous amount of 520,000 h. p. On the American side the old canal which for thirty years has carried water to the bluffs below the cataract is being enlarged until its capacity this spring will be over 40,000 h. p., and, when completed two years hence, will yield 100,000 h. p. Another, and a distinct, company has completed a tunnel under the city which has a capacity to convey sufficient water to generate 100,000 h. p. At present one mill is using the tunnel, taking 3,000 h. p. by gears direct from the wheel shafts, and will eventually put in wheels for 3,000 h. p. more. By June 1, 1894, the tunnel company will have in operation three dynamos, which, collectively, will generate 15,000 electrical horse power. When the proper demand arises, this will be increased to the capacity of the tunnel. The same company own the franchise upon the Canadian side of the river, and are just commencing work upon a tunnel there, which will, when fully completed, have a capacity of 250,000 h. p. And still a third company, this time composed of Canadian capitalists, have just received permission to develop 70,000 h. p. near the Horse Shoe rapids. Remembering that the United States census gives the entire horse power of the great city of New York, including steam heating plants, elevators, etc., at 236,000, the immensity of this Niagara development is seen, and it must be conceded that the day is far distant when this power can all be used at the point where it is manufactured. Referring to the subject of distribution, the writer says that at Niagara, where the severity of the climate makes ice and sleet the foe of overhead wires, and electrical disturbances in the atmosphere are of frequent occurrrence, the engineers have decided that reliability can only be obtained by placing the wires under ground in a subway so large that men can pass through it to give attention to the cables. Twenty-five hundred feet of such a subway has been built as an experiment upon the lands of the company at Niagara. It is 5½ feet high by 3 feet 10 inches wide; is made of Portland cement and gravel, but it cost over $20 a running foot to build. This cost is too great for long distance transmission, and the company now purpose erecting a pole line from the falls to Buffalo, on which experiments will be made. As to the transmission of power to Buffalo, it is stated that the electric lighting company in that place, after having carefully considered the question of Niagara power, has announced the conclusion that electricity could be generated by coal in Buffalo for less than it would cost to bring it from the Falls, and that it would at once erect a new power house in Buffalo. The street railway of the same city, after much consideration, is building two new power houses there, entirely ignoring Niagara. The conclusions of the writer are that the claim that electricity can be supplied from Niagara to all parts of the State of New York is extremely doubtful from a commercial standpoint, though feasible from an electrical one, and intimates that it can only be commercially applied at Niagara alone, and that the popular belief in long distance transmission has been fostered for ulterior purposes in the recent Erie Canal scheme.

Trade and Industrial Notes

THE GENERAL ELECTRIC COMPANY has sold 12 G. E. 800 motors, with six double controller equipments, to the Macon (Ga.) and Indian Spring Railway, and four motor equipments, one 85-h. p. generator and 2½ miles of track material to D. I. McIntyre, of Thomasville, Ga.

J. C. GRANGER & CO., electrical and mechanical engineers, 67 Remsen street, Cohoes, N. Y., make a specialty of complete lighting installations. Mr. Granger, the senior member of the firm, has had a particularly extended experience in mill lighting work, and is well known throughout the northern New York mill district.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has received a contract from Dr. Drysdale, of Philadelphia, for an iron roof over the new power house for the hospital for the insane, at Norristown, Pa., to be covered with anti-condensation corrugated iron covering; also a contract for two cleaning sheds from the McNeal Pipe and Foundry Company, Burlington, N. J.

MESSRS. CHARLES A. SCHIEREN & CO., 47 Ferry street, New York, the well known manufacturers of perforated electric leather belting, have received quite a large order for this belting, consisting of two 32-inch double, four 10-inch double and one 13-inch double belts to be used in the power house of the Richmond Light, Heat and Power Company, Richmond, Ind.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, of which Mr. H. L. Johnson is president, is actively engaged in the manufacture of telephones, magneto bells and other electrical specialties, at its factory in Jersey City. Not only has the sale of telephones increased this company's business to a very great degree, but, combined with the continued success of the Mesco dry battery, has taxed its factory capacity to its fullest extent.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has given agencies for the Wagner transformer to the following firms: Eastern agent, John Mustard, Betz Building, Philadelphia, Pa.; Northwestern and Canadian agent, Wells Goodhue, 1564 Monadnock Block, Chicago, Ill.; Southwestern agents, Western Electrical Supply Company, St. Louis, Mo.

ROSSITER, MACGOVERN & CO., 39 Cortlandt street, New York, announce their removal on May 1 to 141 Liberty street, Central Building, where they will continue their business as electrical contractors and Eastern agents of the Jenney Electric Motor Company. It is their purpose during the summer months to give particular attention to the sale of electric fan motors and installation of ventilating apparatus.

THE BINGHAMTON GENERAL ELECTRIC COMPANY'S VOLUNTARY DISSOLUTION.—Justice C. E. Martin, of the Supreme Court of Broome County, N. Y., on the first day of March on the reading and filing of a petition of a majority of the directors of the Binghamton General Electric Company, ordered that all persons interested in said corporation show cause before Henry C. Olmsted, appointed a referee for that purpose, on the 12th day of June, 1894, why said corporation should not be dissolved.

THE SOUTHERN ELECTRICAL MANUFACTURING AND SUPPLY COMPANY, 110 Baronne street, New Orleans, has issued a catalogue, giving a list of plants installed by it, and a number of very complimentary letters from its patrons. The extent of the business of this company may be judged from a list of its installations, which comprises plants for 33 sugar plantations, 27 oil, saw and cotton mills and sugar refineries, 3 central stations and 19 plants in steamers, breweries, ice manufactories, public buildings, etc. The aggregate of lights installed is 18,236. The repair shop of this company is the largest and best equipped in the South.

THE HARRISON NATIONAL TELEPHONE COMPANY, 44 Wall street, New York, is becoming widely known in the telephone field, attention being attracted by the large number of eminent and wealthy men in its board of directors, and also by the merits of its apparatus. The Harrison international telephone is an electric (not a magneto) telephone, and the patents for exchange system, magnetic bells, lightning arresters, switchboards (which are both automatic and manual), generators and all other devices are the sole property of this company, and consequently free from royalty or tax of any kind which go to make the cost to subscriber excessive. The transmission of vocal sound is clear and distinct, whether long or short distance, and the system embraces both automatic and manual switchboards of the most efficient kind. The patents are claimed to be all valid, and tested in the highest courts. Prominent patent attorneys have stated as their opinion that these patents are original and sound, and in no way infringe on any existing patents.

THE METROPOLITAN ELECTRIC COMPANY, 186 Fifth avenue, Chicago, has just issued a new catalogue, which presents a novelty in the way of its binding. Contrary to the usual custom in catalogues of its size, the Metropolitan catalogue has a cover of soft paper, with strong cloth end binding. The effect of this is that the book will remain open in almost any position, which readers will understand is a great advantage where a catalogue is certain to be opened and referred to frequently. The first 35 pages of the catalogue are devoted to figures and data of "N I. R." wires and cables, and then follow chapters on switches, binding posts, connectors, fuse wire, etc. The "Metropolitan" incandescent lamp is described and listed, together with all sizes of miniature incandescent lamps. The next 55 pages describe supplies of different kinds, and then comes a chapter on "P. & B." specialties, for which the Metropolitan company is general Western agent. Fletcher's specialties occupy considerable space, as also the well known Garton lightning arrester and the "Blair lamp adjuster." Fixtures, shades, lamp sockets, construction tools, for both telephone and electric light work, are carefully catalogued, and special attention is given to fan motors, for both alternating and constant current. The house goods department of this catalogue is very complete. The book contains 452 pages, is neatly printed on good paper, and with its Chinese red cover presents an agreeable appearance.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

POWERFUL PRIMARY BATTERY, for Motors, Cautery or Electric Lamps. All summer Fan Battery and outfit. Boat Motors, $35. Taylor's Booklet of Recipes and Advice, $2.00. Catalogue No. 5 is ready. Taylor Battery Company, 51 Dey street, New York.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MF'G. CO., 2140 DeKalb St., St. Louis, Mo.

THE ALLGEMEINE ELEKTRICITA TS-GESELLSCHAFT, Berlin, Germany, announce herewith that, owing to the general appreciation which their exhibition has met at the World's Fair, it is their intention to appoint selling agents in New York, Chicago, Cincinnati, Atlanta, San Francisco, Boston, Philadelphia, St. Paul, Washington, Denver, etc., for the sale of their manufacture. Trustworthy electrical firms inclined to handle their goods are requested to forward offers to head offices, 22 Schiffbauerdamm, N. W. Berlin.

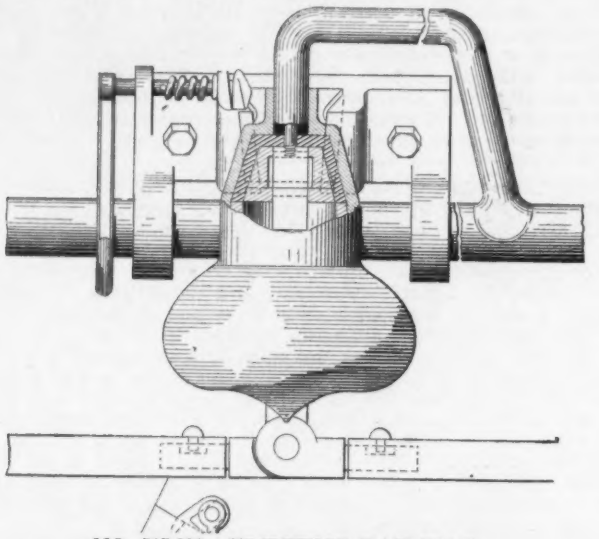
Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED APRIL 10, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

517,831. ELECTRIC POWER APPLIANCE; B. J. Arnold, Chicago, Ill. Application filed Aug. 31, 1892. A speed indicator for a dynamo electric machine, consisting of opposed gear rings, associated one with the driving shaft, the other with a moving part of the machine, and indicators proper actuated one from each ring.

517,858. ELECTRIC MOTOR; E. T. Greenfield, New York, N. Y. Application filed Oct. 1, 1891. The combination with an annular core made up of magnetic sections and non-magnetic sections of solenoids, brushes, of centering rollers and a centering and friction roller. (See illustration.)



NO. 517,886.—ELECTRIC RAILWAY.

517,862. ELECTRICAL FOOT BATH; I. A. Isaacs, New York, N. Y. Application filed Jan. 10, 1894. This consists of a vessel, a ring and voltaic couples thereon, a hot water inlet beneath the pipes, and an outside hot water pipe.

517,866. GOVERNOR FOR ELECTRIC AND OTHER MOTORS; N. S. Keith, San Francisco, Cal. Application filed July 5, 1893. This consists of a dynamo having its field magnet mounted to be rotatable in one direction by the torque of its armature on its field magnet, and rotatable in the other direction by a spring or weight, and means to control the supply of electricity to the dynamo.

517,884. RAIL CUSHION; T. C. Paulsen, Chicago, Ill. Application filed Dec. 29, 1893. The combination of a rail connector of two caps closed at one end, with a wire having one end inserted into the opening of each cap, the caps having the metal partially cut away on one side.

517,886. ELECTRIC RAILWAY; H. S. Pruyn, Hoosick Falls, N. Y. Application filed Nov. 1, 1893. In an electric railway system, a sectional conductor having rigid insulated joints and flexible insulated joints. (See illustration.)

517,940. ELECTRIC RAILWAY SYSTEM; C. D. Tisdale, Boston, Mass. Application filed Jan. 17, 1893. The combination with a railway rail, of a sectional conducting rail provided with contact pins, an elastic support for the conducting rail, a main conductor, contact pieces, and support for the same.

517,948. METHOD OF, AND MEANS FOR, SPEED REGULATION OF ELECTRIC LOCOMOTIVES; C. E. Emery, Brooklyn, N. Y. Application filed Oct. 14, 1892. This consists in connecting a generator, at will, with motors which severally develop different counter electromotive forces at like speeds of the car, thereby operating the car at different speeds for the same available voltage.

517,957. ELECTRIC SWITCH; A. T. McCoy, Boston, Mass. Application filed April 13, 1893. The combination of two levers, a pivot for the same, and a spring to maintain the levers one upon the other on the pivot, one of the levers being provided with prongs projecting at right angles to the same to meet the other lever and move the latter.

517,997. MODE OF CONNECTING DYNAMOS TO CAR AXLES; W. Biddle and P. Kennedy, Brooklyn, N. Y. Application filed July 3, 1893. This consists of divided rings clamped upon the axle of a car wheel, an armature surrounding the axle and armature rings in halves at the ends of the armature, screws for clamping same, field magnets at opposite sides of the armature, supporting frames for the same and half circle bearings surrounding the sleeve upon the axle and bolts for connecting the half circle bearings.

517,998. ELECTRIC CAR LIGHTING SYSTEM; W. Biddle and P. Kennedy, Brooklyn, N. Y. Application filed April 20, 1893. The combination of a car axle and a dynamo, a divided sleeve bolted upon the axle, a divided ring around the sleeve and bolts for connecting the same to the dynamo frame, and a link between the dynamo frame and the truck frame for suspending the dynamo.

518,006. ELECTRIC LOCOMOTIVE; W. Lawrence, New York, N. Y. Application filed Jan. 21, 1893. The combination with a commutator having contacts, with brushes, a rocking shaft for moving the brushes into engagement with the contacts and with brushes.

518,015. ICE-CUTTING TROLLEY; R. W. Thompson, Cleveland, Ohio. Application filed Nov. 4, 1893. In a combined trolley and wire stripper, the combination of a centrally perforated hub provided with a grooved disc and concentric peripheral rings completing the sides of the groove.

518,033. ELECTRIC MOTOR; J. C. Henry, New York, N. Y. Application filed Aug. 19, 1890. The combination in a brush holder of a divided arm supporting the brushes, having tapered screw above and handle screwed thereon.

518,037. ELECTRICAL ANNUNCIATOR; R. L. Hunter, St. Paul, Minn. Application filed Feb. 13, 1893. This comprises a disc supplied with a series of notations, a stationary face plate having a separate opening for each series, and a cut-off plate arranged to cover and uncover the openings so that only one is open at a time.

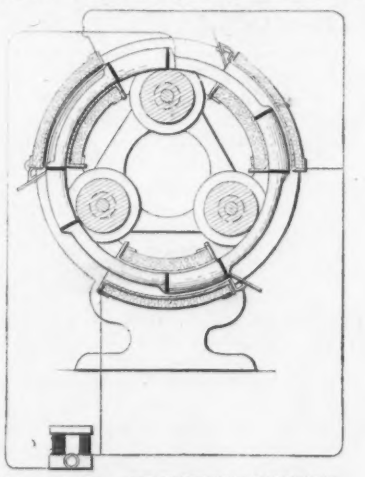
518,062. SPEED AND POWER REGULATOR FOR MOTORS; H. B. Gale, San Francisco, Cal. Application filed June 21, 1893. The combination of a motor, an auxiliary generator and secondary battery for regulating the power thereof, and electrically operated valves controlling the supply of working fluid to the motor.

518,071. TROLLEY WIRE INSULATOR; L. McCarthy, Boston, Mass. Application filed June 8, 1893. This comprises an outer case, having arms to secure the same to the span wire, an insulated portion fitting within the case and a screw connecting piece for securing the insulator to the clip on the trolley wire, the case having a downwardly projecting skirt extending below the lower portion of the insulator proper.

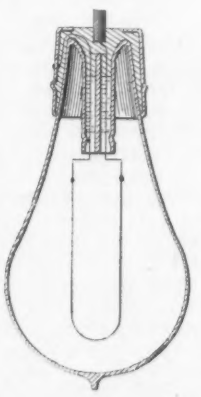
518,092. PERMANENT MAGNET; A. T. Collier, St. Albans, England. Application filed Jan. 8, 1894. This consists of a bar or bars formed as a loop or coil, having the ends crossing each other and both extending inward toward the interior of the loop or coil to constitute two poles.

518,133. ELECTRICAL CONTACT MECHANISM; J. F. Blake, New Haven, Conn. Application filed Jan. 25, 1894. This comprises a lever provided with terminals and with an insulating portion, a rolling contact adapted to travel between the terminals and the insulating portion, and a hollow spring connected to the lever to receive pressure for actuating the same.

518,142. TELEPHONE TRANSMITTER; J. and H. M. Goodman, Louisville, Ky. Application filed Aug. 19, 1893. This comprises two magnets and a mass of metal susceptible of magnetic induction, and in a state of comminution, between the extremities of the magnets, in combination with a vibrating diaphragm mechanically connected at or near its centre with an extremity of one of the magnets, and an electrical condenser.



NO. 517,858.—ELECTRIC MOTOR.



NO. 518,179.—INCANDESCENT LAMP.

518,179. ELECTRIC INCANDESCENT LAMP; J. E. Criggal, Springfield, Mass. Application filed Dec. 8, 1893. A lamp bulb having supported within its neck two tubes of glass, which are open from end to end, the leading-in wires passed longitudinally through the tubes, a cement or plastic material filling and closing the inner ends of the tubes, a quantity of mercury in the tubes above the inner end-filling, and a filament connected to the inner ends of the leading-in wires. (See illustration.)

518,188. CIRCUIT SWITCH; E. E. Hersh, B. F. Woodward and J. W. Pettee, Denver, Col. Application filed Oct. 25, 1893. This comprises a casing, a T-shaped rotatable switch block, two contact brushes adapted to engage the block, an apertured face plate, and a single push button for actuating the switch block.

518,198. ADJUSTABLE ELECTROLIER; C. M. McCamey and S. H. Root, Longmont, Col. Application filed Dec. 5, 1893. The combination of depending stationary metallic tubes insulated from each other and connected with the feed wires, metallic rods telescoping within the tubes and provided with adjustable spring contact brushes, the outer tubes insulated from the inner tubes, an insulating base connecting the rods, and lamp wires respectively connected with the rods.